HEATING AND VENTILATING

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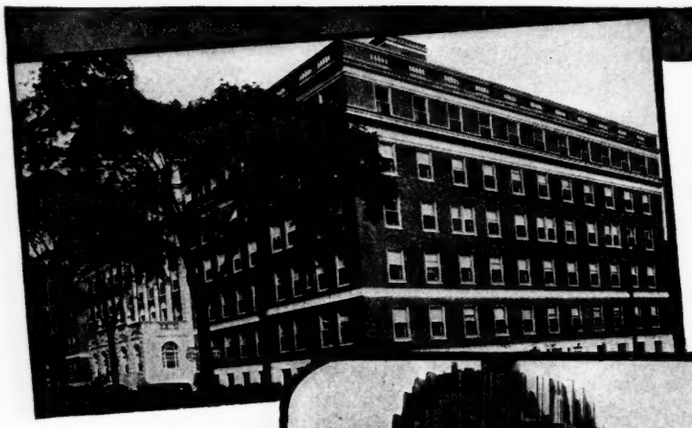

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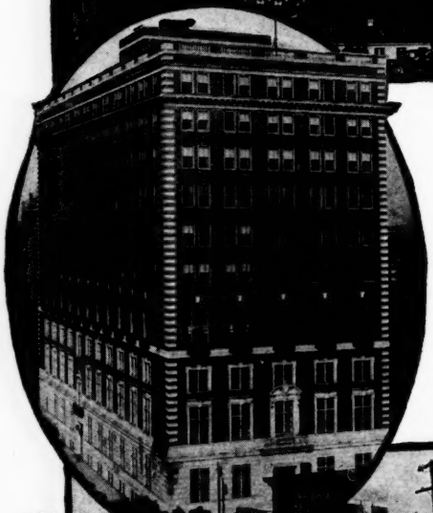

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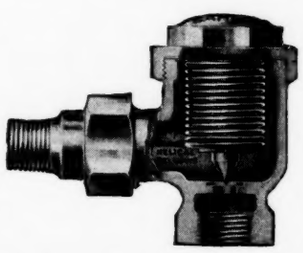

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Radiant Heating

HEAT from radiant sources was undoubtedly the original form of building heating used in this country. The old-fashioned fireplace, so vividly described and so disparaged by Franklin in his classic paper on the methods of heating practiced in the American colonies, was a radiant heating device. Franklin's stove which came into such popularity seems to have led the way in establishing convective heating. Since his time heating practice in this country has inclined sharply toward convective methods.

This course has not been nearly so generally followed in England. Just why the English methods have shown such a different trend is not clear in spite of the many opinions advanced. Undoubtedly temperament, habits, climate and construction have had much to do with the methods followed by the British in heating their buildings. At any rate, the open fireplace has occupied a more important position in British practice than in ours. Consequently, a strong tendency toward the use of radiant heating devices has survived in England.

These two different backgrounds in method largely account for the course which the more recently developed methods have taken in the two countries.

In the main, true to tradition, this country has tended to develop convective methods. The undoubted fact that American-devised methods in processing air for both domestic and industrial uses are outstandingly successful bears witness to the progress made in this direction. All the methods of air heating by circulating air past a heated surface are widely and successfully used here and the art is well developed. Radiant heating, however, has been largely confined to the traditional radiators which are a compromise and are neither wholly radiant nor wholly convective. About the only radiant method to be used has been the electric beam type of heater used for auxiliary supply.

In England developments have been made toward wholly radiant methods. Within recent years the panel, baseboard, and flat-surface-heater methods have moved ahead rapidly. While their introduction has not been general or universal neither have "air conditioning" methods come into universal use in this country.

On the whole it seems fair to state that the two methods are in about the same general state of development. In each case, a considerable body of basic information has been built up; in each case commercial forms of apparatus have appeared and have been somewhat charily used; each appears to be on the verge of increasing acceptance in the respective countries. Still more striking is the similarity of their claims of producing "comfort" although each sets up different standards in doing so.

Briefly stated, the general theory behind both of the methods is the same. Each accepts as a starting point the general premise that comfort depends upon the human body losing its heat to the environment at such a rate and in such quantities as not to upset or overtax the heat-regulating apparatus of the body. Each realizes that the control of the rate of heat loss must act externally of the body. The divergence is in the method of control.

The radiant heating method consists of supplying enough heat to the surface of the clothing in radiant form to keep the net heat loss at the desired point. Since air is largely transparent to radiant heat it is possible to keep the heat loss from the body at the desired point without changing the temperature of the air greatly. In other words, in the radiant method, control of heat loss is achieved by varying the supply of radiant heat while the air temperature remains substantially constant.

With convective heating no (or little) radiant heat reaches the clothing surface and the net heat loss is governed very largely by the temperature, or so-called condition, of the air.

The principal differences between the two methods are at once apparent. In the one method, comfort is largely a function of the air temperature and in the other it is much less dependent on the condition of the air.

We, in this country, have been largely led to believe that comfort is fully defined and determined when a certain set of experimentally determined values of "temperature, humidity, and air motion" are achieved presumably by convective methods. Perhaps so, but the point is: *Are we sure that those conditions are the only way in which it can be obtained?*

Some of the recently built English buildings have reported surprisingly low energy consumptions. Moreover, calculations of peak requirements seem to show less installed capacity than is currently used in this country. If these reports are substantiated, is it not quite possible that not only may comfort be achieved under different temperature and humidity conditions but that it may be done with less energy?

At any rate, the whole subject of radiant heating gives so much promise that it deserves more attention than has been paid to it. Let us hope that some agency may be found which will disclose the true facts in the case before we become too firmly wedded to the idea that the present conception of temperature, humidity and air motion represents the final word.

Welded Fabrication of Ductwork

by **William Spraragen***

USE of welding has become almost universal in the joining of metal parts where a permanent, strong and tight joint is required. Its range of applicability varies from the lightest gauge materials to plates 4 in. in thickness. However, in this article particular attention will be given to the fabrication of thin sheet steel.

As there is no sharp line of demarcation between sheet metal and plate, the author has arbitrarily chosen 1/8 in. or No. 11 gauge as a dividing line. However, some of the methods described are applicable to plate metal. The technique, unless otherwise stated, applies particularly to sheet steel, although other metals such as aluminum, copper, brass, lead, monel metal and special alloy steels are available in sheet form. Welding of these metals and alloys must receive special consideration.

In the sheet metal industry welding is used wherever a permanent type joint is needed which is able to withstand stresses, and in many cases it is also used to overcome corrosion problems. Among the advantages are simplification in the design, layout and cutting of members to be joined. Moreover, in many instances the excellent appearance of the resultant finished product when fabricated by welding is a feature of paramount importance. The type of joint and its preparation will be somewhat dependent upon the processes of welding to be used. In turn, the choice of welding processes will depend on the particular product to be fabricated as well as such factors as quantity to be welded, cost, distortion problems and other matters of a similar nature.

PREPARATION OF MATERIAL IN REPETITIVE PRODUCTION WORK

Use of patterns for preparation of material is generally essential. This is usually a matter for the drafting room which has the necessary experience in applied descriptive geometry. In fact, this layout work is somewhat similar, regardless of the method of fabrication, although drafting room work is considerably simplified, as it is not necessary to match rivet holes and allow for clearances and tolerances of riveting tools. Moreover, lap joints may often be eliminated. This type of joint sometimes causes considerable difficulty at angles, corners and curved surfaces. Templets are sometimes used to advantage.

CLEANING

As in all welding processes, grease, dirt, rust and corroded metal should be removed. The edges of the sheet must be clean.

It is customary to remove the galvanizing from the edges to be joined by welding. The zinc galvanized coating forms an alloy in the steel

*Technical Secretary, American Welding Society

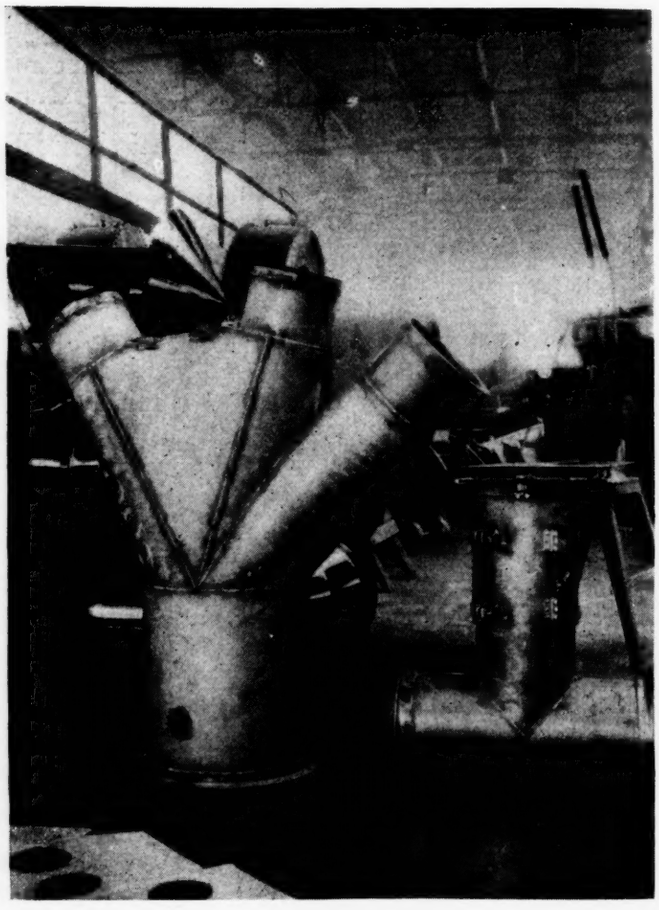


Fig. 1. Three-Way Arc-Welded Warm-Air Duct

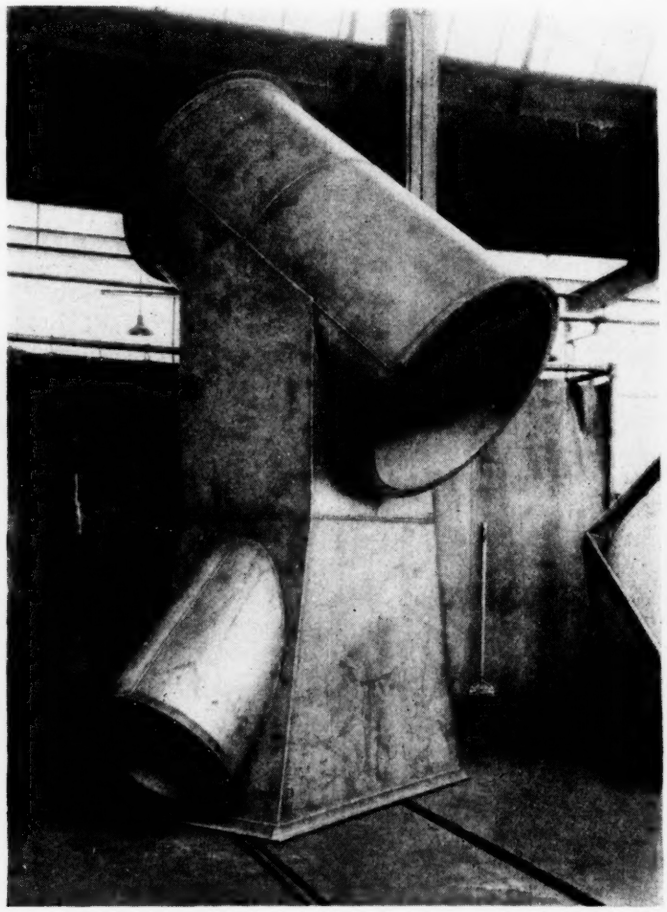


Fig. 2. Difficult Pipe Section Arc Welded

in the weld, making it weak. Moreover, the heat of the welding arc or torch will volatilize zinc, producing unpleasant fumes. Removal of the galvanizing for a narrow strip may be done by a weak solution of acid or by burning. In the latter case, ventilation of the fumes is necessary. A wire brush may be used to clean the area from which the coating has been loosened.

Galvanized sheets can be welded with bronze welding rod using the oxy-acetylene torch. With the use of this rod it is unnecessary to remove the zinc from the edges of the seam to be bronze welded. In fact, no preparation other than cleaning is required. A seam welded with the bronze rod has ample mechanical strength. Less heat is required and therefore a smaller size tip than in steel welding. This minimizes the tendency of the sheet to buckle.

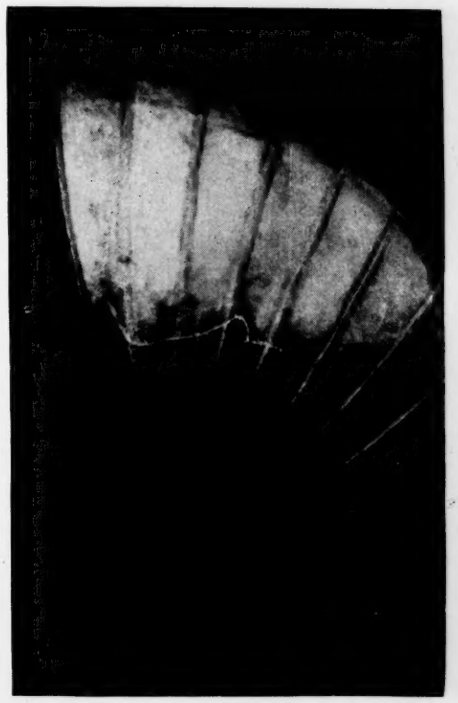
Edges of the sheet to be joined are simply butted together, considerably less spacing being used than for steel welding. Flux is used either by dipping the heated rod or by painting with paste of flux and water. The flame is kept neutral and when the edges of the sheet reach a dull red heat a drop of the molten bronze is allowed to fall from the rod. If the metal is at the right temperature, the molten bronze will spread over the hot surface, forming a thin adherent film. More bronze is added from the rod until a slight reinforcement is obtained.

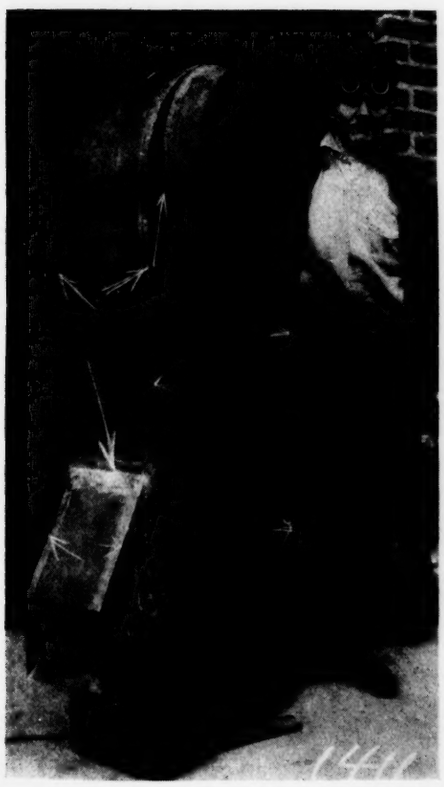
Fig. 3. Arc-Welded Compound Branch Connection for Heating System

TYPES OF JOINTS

It is not necessary or desirable to bevel the edges of sheet metal. There is a variety of types of joint available which may be roughly divided into butt, flange, lap and special forms of corner joints. Each has its particular advantages and field of usefulness. The order of welding, provision for expansion and contraction and methods of overcoming distortion are all items which must be given careful consideration by the designing and welding engineer. Some of these joints are illustrated in Fig. 8.

In oxy-acetylene, carbon-arc and atomic-hydrogen welding the flange type of joint is particularly useful on light gauge sheet. As the name implies the edges are flanged and brought together and the weld is made by fusing down the projecting edges without the addition of the welding rod. Special precaution must be taken to secure complete penetration to the bottom and the elimination of oxides that are likely to exist between the sheets which may prevent proper fusion.

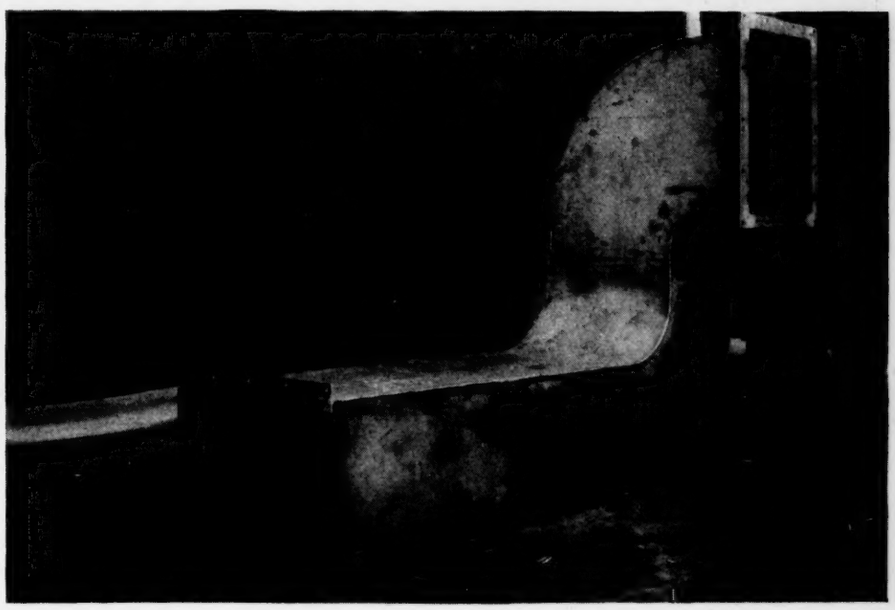




Left:—Fig. 5. Oxy-Acetylene Welded Ventilating Duct

Right:—Fig. 4. Oxy-Acetylene Welded Ship Ventilator

Below:—Fig. 6. Arc-Welded Compound Elbow



Materials up to 14 gauge can be flanged by machines which are available at the metal shop equipment. Heavier metal can be flanged in presses and special apparatus.

During welding, the flanged edges are usually held in place with clamps or by tack welding. The amount of reinforcement will be governed by the depth of the flange in most cases. If a flush weld is desired a narrow flange should be used.

EXPANSION AND CONTRACTION

In sheet metal welding one of the most important matters to be considered is the matter of expansion and contraction and their control, while the joint is welded and in cooling. The heat of welding causes expansion at the edge of the sheet and as the sheet cools after welding contraction takes place. These are not always balanced. Proper consideration to avoid buckling and distortion in the sheet is necessary. Allowance is made for the movement in the sheets by clamping in properly designed jigs, by tack welding or by spacing the far ends of the sheet a sufficient distance apart to allow for the movement. The amount of spacing is dependent on the thickness of the materials, dimensions of the sheet, size of welding tip, size of electrode and current and the speed of welding.

Heavier sheets require greater spacing than the lighter sheets. For sheets of the same thickness the spacing will be directly proportional to the length of the seam. A speedy operator will need less spacing than the slower welder.

Controlling expansion and contraction in sheet metal by means of jigs and fixtures is coming into increasing use, especially for repetitive work. The jigs serve the purpose of restricting the movement of the parts during welding and also in conducting away the heat and therefore minimizing forces resulting from the heat. The principal advantages of jigs other than convenience are economy, accuracy and speed. Their use is synonymous with mass production and standardization.

Tack welding is often used to hold sheets in position. The distance between them varies from 3 to 12 in. When tack welding is used care should be taken to avoid buckling in a vertical position.

ASSEMBLY

In large diameter pipes and elbows when using light gauge metal (14 and lighter) the use of a spot welder is of considerable assistance in the assembly work. A lap joint is sometimes used which brings the joints tightly together and permits much faster work than would the butt joints.

For non-repetitive work, it may be found advisable to train assemblers whose duty it is to tack the work together and lay it aside for the welder to complete.

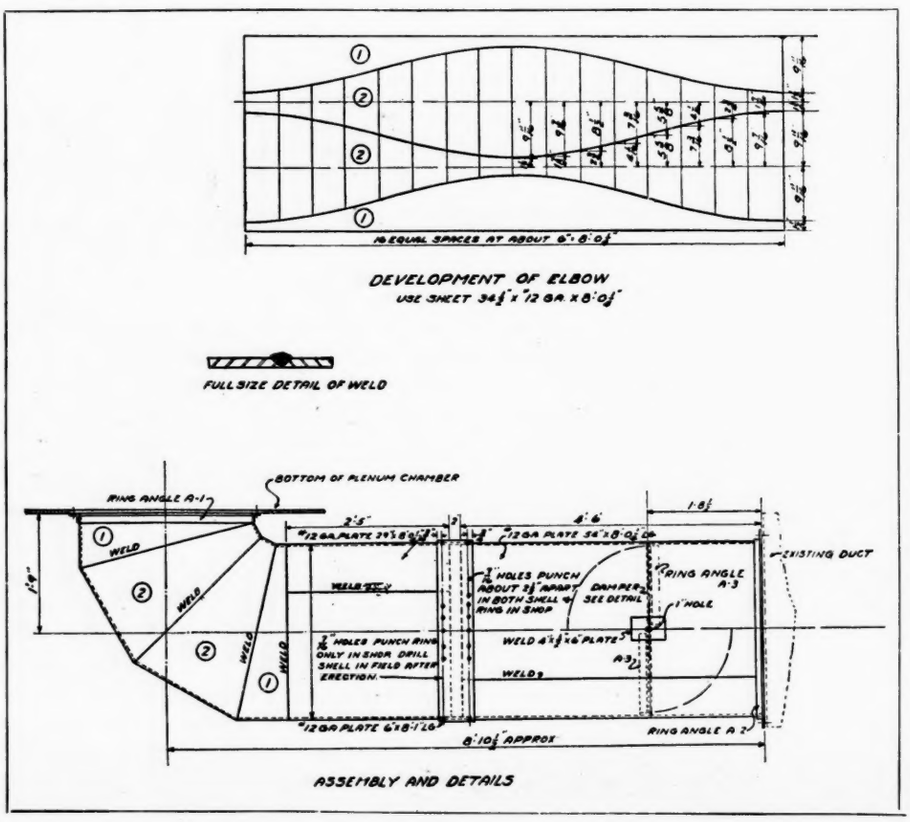
In selecting an assembler for this class of work it is desirable to train a man with previous mechanical experience and who is able to read a blue-print.

QUALITY OF SHEET

The welding quality of the sheet has much to do with the quality of the resultant weld. This is not a matter of chemical composition alone but rather how it was made and the impurities in it. A good clean steel with a low carbon content is generally preferable.

WELDING ROD

Where a welding rod is used its size would depend upon the thickness of the sheet. In gas welding, a 1/16 in. wire is generally used for all thicknesses of metal up to and including 1/16 in. sheet and 3/32 in. wire up to ⅛ in. sheet. In arc welding, an ⅛ in. electrode is used for the light gauges and a 5/32 in. wire for the heavier material.

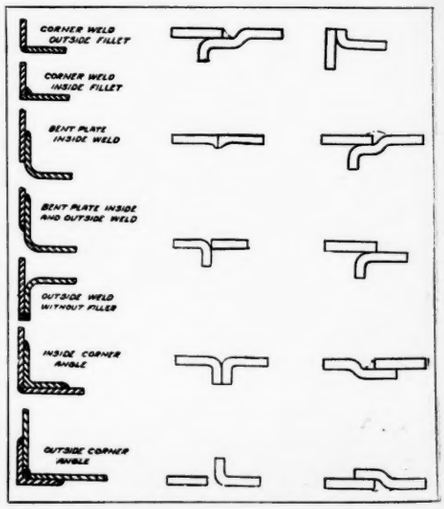


DUCTS

Fig. 7 illustrates an air duct of circular cross-section. The straight sections with longitudinal butt welds are, of course, simple, as are the ring

Fig. 7. Welded Air Duct
(Courtesy Eastman Kodak Company)

Fig. 8. Various Types of Joints


CORNER WELD OUTSIDE FILLET
CORNER WELD INSIDE FILLET
BENT PLATE INSIDE WELD
BENT PLATE INSIDE AND OUTSIDE WELD
OUTSIDE WELD WITHOUT FILLER
INSIDE CORNER ANGLE
OUTSIDE CORNER ANGLE

angles. The pieces for the elbow were all laid out in the drafting room by simple computation, so that all that is necessary to do in the shop is to lay out the coordinates to the dimensions given. Note that there is no waste of material. If the cutting is done by a torch, sufficient cutting allowance must be made. After cutting, the plates are rolled to a circular form and the longitudinal seams butt welded, the pieces are then tacked together and the circumferential welds completed. Four ducts were made welded as shown, four similar ducts were previously made riveted with a very good grade of workmanship, and both were installed side by side. A look at both will convince even the casual observer of the superior job obtained by welding.

A Chicago manufacturer builds a system consisting of a grinding mill and pulverizer, an air separator, exhaust fan, cyclone collector, a tubular duct collector and the necessary connecting pipes. Construction of one of these mills necessitates the use of a wide range of thicknesses of sheet metal and a great variety of joint design. Tops for air separators, return air housings, fan housings, etc., are all welded. As a result of the applications of welding, the finished product is more economical and stands up better in service than riveted joints. Moreover, the parts are absolutely dust tight. A considerable saving is also effected in the designing room, particularly in the matter of drawings, which is a considerable part of the total cost of such a structure.

The superintendent of this company states that 95% of the company's present work is made of black iron instead of galvanized sheet. Through the use of welding there is a saving of more than 25% in the raw material and as high as 50% in labor for certain classes of work. Pattern work for the riveted process requires a great deal of extra time in laying out rivet spacing and proper laps.

Fig. 6 illustrates a compound elbow of No. 10 gauge material used with an air heating system. It would be a difficult task to turn over the edges for a riveted job or form an angle to fit into the corner. No trouble at all is encountered in making a corner weld of this nature.

The three-way branch illustrated in Fig. 1 is a warm-air duct used in an air heating system. The parts of No. 12 gauge material are butted together and welded. Different openings are cut with the torch after the branch is completely welded. A lot of rivets would have to be used in connection with a piece of work of this sort to make it dust tight. Two more difficult pipe sections are illustrated in Figs. 2 and 3 forming part of an air heating system. These would be extremely difficult to manufacture by riveting.

STACKS

A manufacturer of both riveted and welded stacks states that a rapidly increasing number of owners are demanding the welded product. Considering the efficiency of joints in a stack, welded construction gives 100% as compared to 60% in the riveted types. Breachings and gas and smoke conductors in a stack generally allow leakage when riveted, which spoils the vacuum, hence handicaps the draft. Of course, when these parts of the stack are welded, the joint is 100% air tight. Joints of a stack that must be subjected to heat strains can be held tight when welded, where they will give if riveted. Moreover, a welded stack has no rivet heads or rough edges to collect soot and soft coal, which form sulphuric acid and eat into the stack.

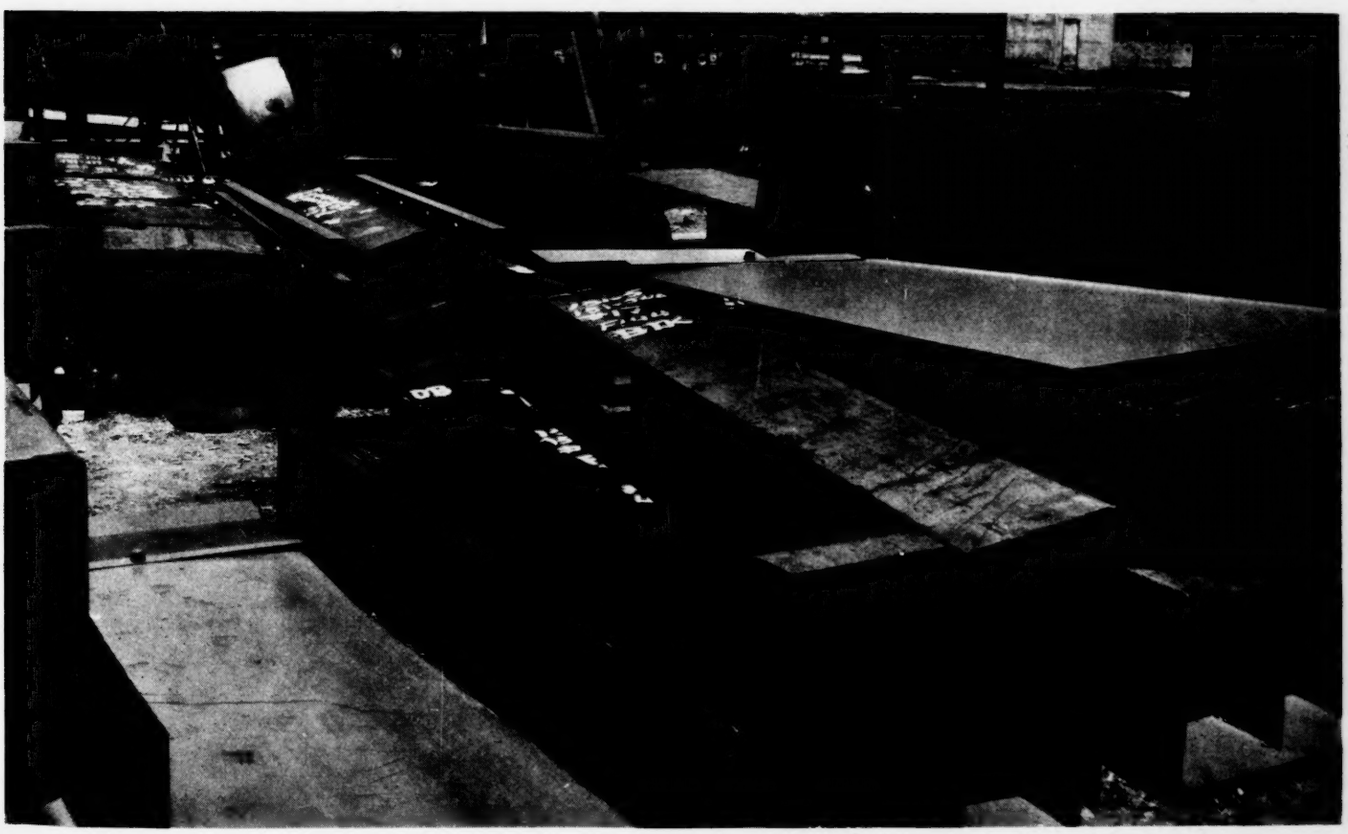


Fig. 9. Arc-Welded Ducts for Merchant Ship Ventilating System

Heating Apartment Houses with Oil

by **J. J. Spalding, Jr.***

THE average modern apartment house gives comfort, convenience and a good appearance for a minimum rental. Rents are dependent on the capital invested and on the maintenance costs of the building. Heating and hot water are generated by burning fuel under boilers. The cost of fuel, the necessary boiler room labor and the cleaning of halls, stairways, etc., form a large per cent of maintenance outlay. Solid, liquid and gas fuels are available in most all parts of the country. Their relative value in cost per unit of heat varies in different localities. Along the seaboard and at many interior points certain grades of liquid fuels are low in price.

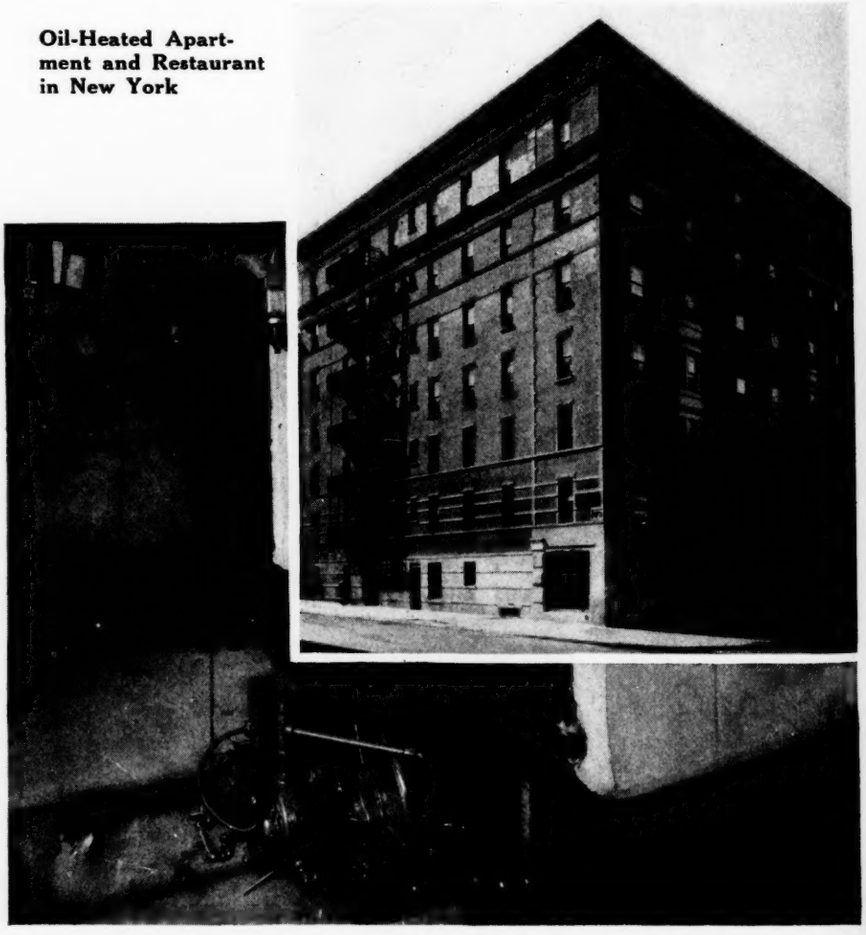
A mechanical unit that requires practically no attention and gathers its own fuel from the storage container, that will fire boilers with a fuel that gives off no dust or noise when delivered, that burns the fuel without smoke or odor or soot, that leaves no ashes to be removed and that has long life and low up-keep cost is a valuable asset to apartment house owners and tenants. Besides decreasing or eliminating boiler-room labor, a device of this nature reduces the cleaning bill caused by dust, ashes or smoke which filters from the boiler room or from the sidewalk or court, where refuse is loaded on trucks, into the building.

A suitable fuel oil burning system, when properly installed, meets all the above conditions. The amount of liquid fuel passing through the burner and into the combustion chamber of the boiler is controlled by a simple valve whose function is understood by the most ignorant of janitors. When this valve is set at a given position a constant fire will burn under the boiler indefinitely. If an adjustment of the fire is needed, the valve is moved and the flame responds immediately to the increase or decrease of fuel. Owing to this factor, variable heat demands are promptly satisfied, and little experience is essential to fire boilers with this type of fuel. The size of the flame in most fuel oil burning installations under boilers is controlled within wide limits by steam pressure or temperature and not by manual setting of valves.

In 1924, the Duncan Apartments, at that time the largest apartment house in Northern New Jersey, purchased a fuel oil burning system. The heating plant consisted of three, 9,500 ft. steel boilers for generating steam, and one down draft smokeless boiler, rated at 6,000 sq. ft., for generating hot water and for burning garbage and refuse. All the burners fire into the ashpit of these boilers. The sylphon damper regulators on the boilers were attached to the air and oil control valves of the burners so that the steam pressure and water temperature would automatically govern the quantity of oil burned between a maximum and minimum fire. Two motor-driven fuel-oil pumps were installed, each having sufficient capacity to fire all the burners continuously. The piping of this system was installed so that a No. 6 fuel oil could be burned when a fuel oil preheater, a fuel oil temperature control and thermometers were installed in plugged outlets left in the fuel oil piping. The storage tank was equipped with coils, and connection brought into the boiler room and capped. In 1924, No. 6 gravity fuel oil was not available for delivery at this location.

During the eight years this plant has been in operation the fire-boxes have been rebuilt only once and a new motor was furnished for one of the fuel oil pumps. Outside of these repairs and a few minor parts such as an oil pressure gauge, there has been

Oil-Heated Apartment and Restaurant in New York



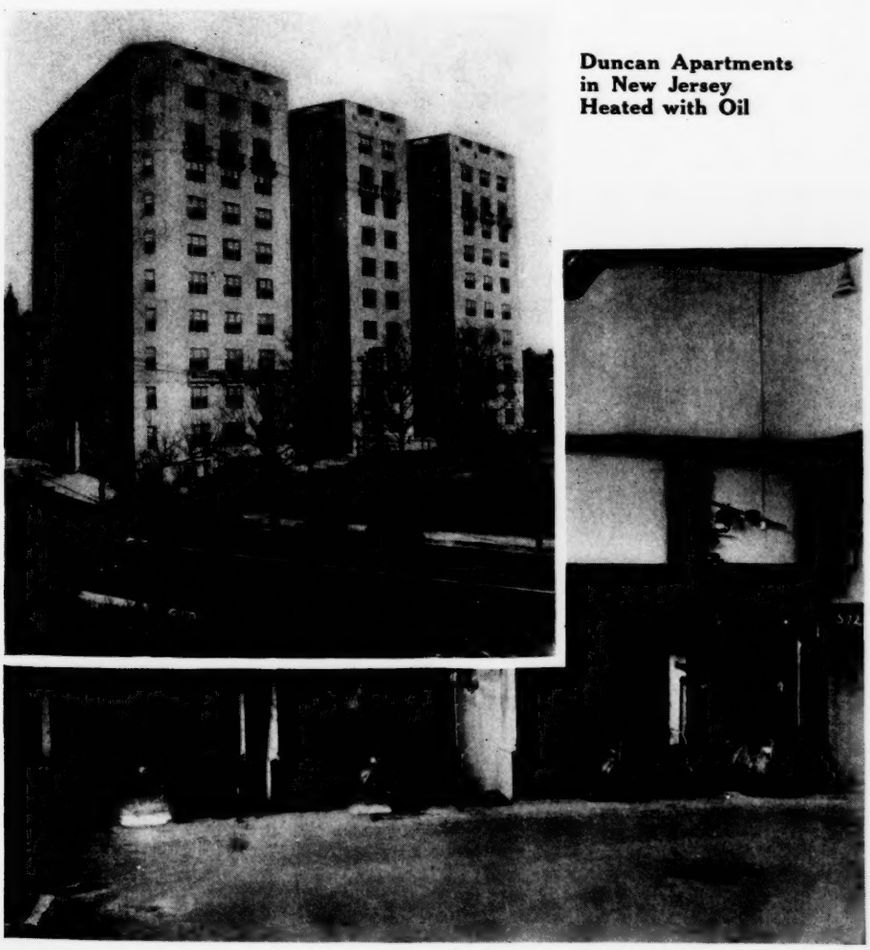
*Engineer, Preferred Utilities Co., Inc., New York.

no other maintenance cost. All equipment used on this job was of heavy substantial construction but of standard design and workmanship. According to the owners, the fuel cost per apartment is low and they are not interested in installing preheating equipment so that they could change from No. 4 oil to No. 6 oil.

Oil burners are divided into three classes, full - automatic, semi - automatic and manual. Full - automatic burners are operated by thermostats placed in the building to be heated or from the boiler steam pressure, or water temperature in the boiler. When thermostats are used they are generally located in the apartment of the owner or superintendent. Controlling the heat in all except very small apartment houses by the latter method is never fully satisfactory as the apartment containing the thermostat either requires less or more heat than the others. The temperature in this one apartment shuts down the fuel oil burning system or cuts it on. If this apartment requires less heating than the average, some of the tenants suffer and if it requires more heating, fuel is wasted in the other parts of the building.

When burners are operated full-automatically from the boilers they are controlled by pressure or temperature instruments. These instruments are adjustable so that the pressure or temperature at which the burners will shut off can be varied to meet weather conditions. Some of these instruments are constructed so that the differential between the stopping and starting pressures or temperatures can be varied and thereby increase or decrease the time the burners are full on or full off. This type of automatic operation is practical and satisfactory to tenants as they always have heat and hot water. However, it does not give automatic control of the temperature in any apartment and if windows are opened instead of adjusting radiators fuel is wasted.

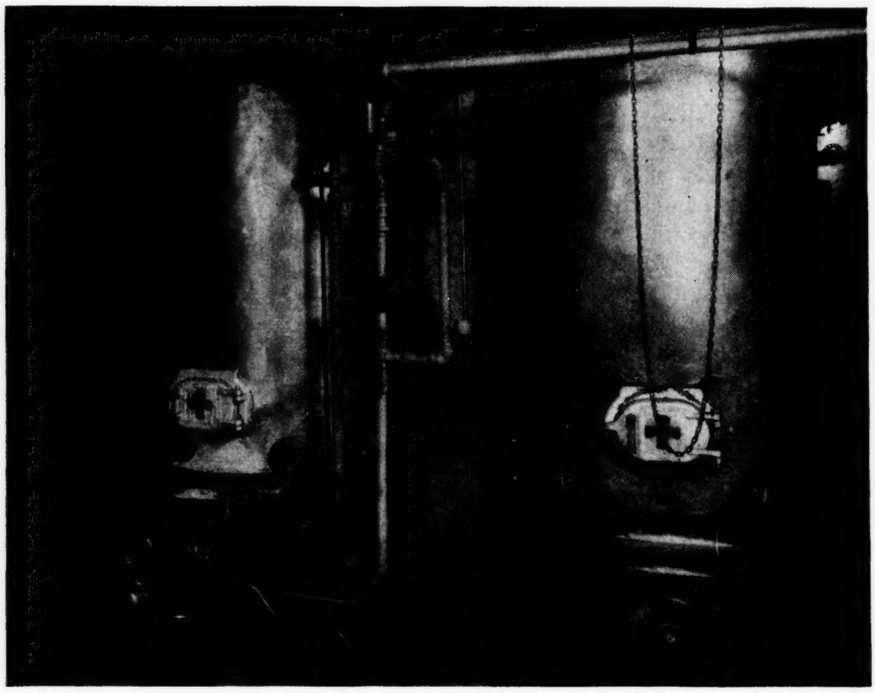
In the Middle West, many apartment houses that are mechanically heated are installing a new type of self-contained electric motor-operated valve that is automatically controlled by a thermostat placed in the living room of the apartment. The automatic control of radiators, thermostatically, and of fuel oil burning systems, by boiler pressure, gives the most economical automatic heat, as it is not necessary to raise windows on account of overheated rooms. Each tenant can have any constant room temperature he wants.



Duncan Apartments in New Jersey Heated with Oil

Many small apartment houses require only a part-time janitor. When such apartments use one boiler to furnish both heat and hot water some means must be employed to close off the heating system not only during the warm months but frequently for part of the day during the first and last part of the heating season. Hand valves in the main risers cannot be suitably regulated by a part-time janitor and frequently the apartments will be too hot or too cold. To meet this condition mechanically a positive tight closing and opening compact motor-operated riser valve of either straight or angle pattern is frequently used in small apartments and homes. When the boiler is fired with a thermostatically-controlled burner the riser valve is automatically opened when the thermostat calls for heat and closes after sufficient heat has been delivered. If the temperature of the water in the hot water storage tank is below normal the control on this tank will start the burner and it will continue to operate until the water reaches the desired temperature or until the safety pressure or temperature switch of the boiler shuts the burner down. The thermostat will start the burner, however, if heat is required in the building regardless of the temperature of the water in the storage tank.

The apartment house at 102nd Street and Broadway, Manhattan, is an old building that was remodeled. The Old Algiers Restaurant is located in this building and occupies 16,250 sq. ft. of floor space, using one and one-half floors and the basement. The steam tables and the hot water for the restaurant are supplied from the heating boilers. The heating plant consists of two, 13,000 sq. ft. cast iron boilers each equipped with one fuel oil burner. The upper floors are divided into sixteen apartments having a total of 102 rooms. The restaurant is open fourteen hours a day. Due to the necessity of steam pressure at all times and the rather light steam consumption in warm weather, full-automatic burners were installed so that requirements could



Oil-Fired Boilers in Orienta Apartments, Mamaroneck, New York

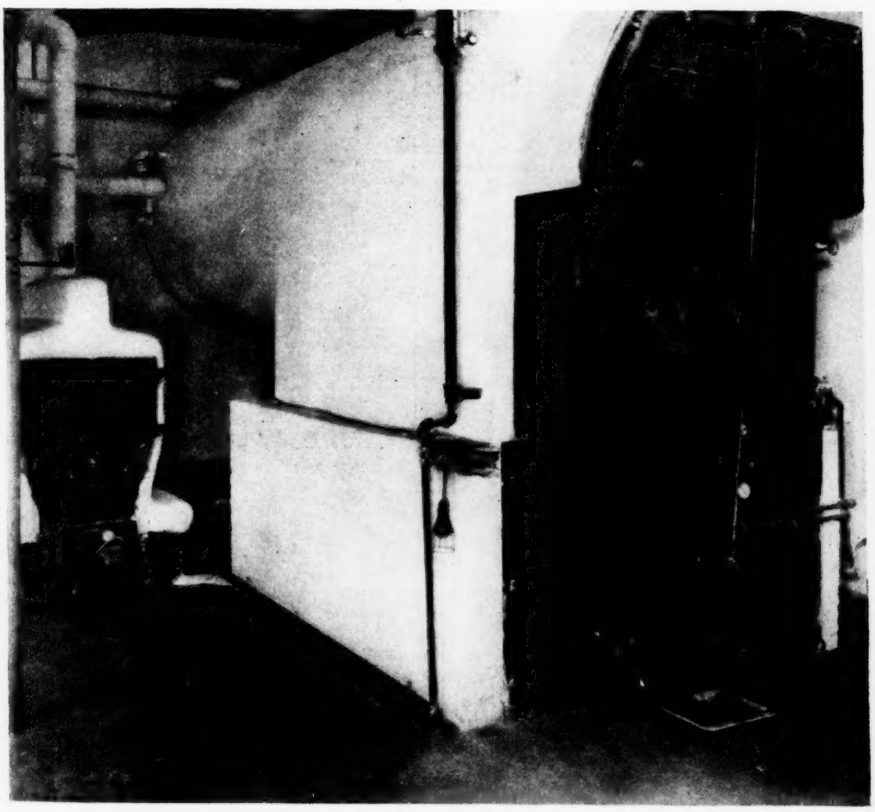
be met accurately without the necessity of boiler room help. No. 5 fuel oil is burned under these boilers. The fuel cost averages about $2,400 a year.

Most of the average size apartment houses burning fuel oil under heating boilers are equipped with semi-automatic fuel oil burning systems. The steam pressure operates a control that automatically varies the fire furnished by the burners between a minimum and maximum range. This range is sufficiently flexible to maintain constant boiler pressure except in mild weather when the minimum flame is likely to build up excessive pressure in the boiler unless it is inspected occasionally by the janitor. Frequently, however, if the hot water for the apartment is supplied by a separate boiler, it is equipped with a full-automatic unit. In such cases the heating boiler is used in the winter time to supply steam for making hot water and the hot water boiler is fired automatically during the warm months of the year.

The boiler room of the Kelvin Apartment on 108th Street, Forest Hills, Long Island, is shown by the accompanying illustration. The heating equipment consists of one steel steam boiler rated at 15,000 sq. ft. and a cast iron boiler for heating hot water. The heating boiler is equipped with a semi-automatic burner firing No. 6 fuel oil. The hot water boiler is fired by a full-automatic burner having a maximum capacity of 5 gal. of fuel oil per hr., and using No. 3 fuel oil. The heavy oil that requires preheating is stored in a 5000-gal. tank and the lighter oil in a 2000-gal. tank. During the heating season of about 7 1/2 months, steam from the large boiler is used for heating the hot water. In the warm months the full-automatic burner is used for hot water. The average consumption of No. 6 fuel oil per season is 56,500 gal. at 4 cents per gal., and 6500 gal. of No. 3 oil during the warm months at 7 cents per gal.

When apartments are equipped with only one heating boiler and when this boiler is used to generate steam to make hot water in the warm months, it is necessary to start and stop the burner frequently. To overcome the labor cost of lighting and turning off a semi-automatic burner and carelessness of operators, the above type of installation is frequently made.

The Orienta Point Apartments at Mamaroneck, New York, is located on Long Island Sound. This building has 76 apartments and a total of 218 rooms. The heating plant also furnishes heat for a 52-car garage located about 75 ft. from the building. There are two, 9,000 ft. steel boilers in the boiler room fired by semi-automatic burners. This fuel oil burning system uses $3000 worth of No. 6 oil per year. Steam is supplied from the boilers to a hot water heater the entire year. In mild



Boiler Room of Kelvin Apartment House, Forest Hills, Long Island

weather only one boiler is operated and when no heat is required one burner can be run at a low fire for several hours to generate steam for the hot water heater without building up pressure on the boiler. During the heating season the boilers are started at 5 a. m. and are shut down at midnight. The janitor and night watchman are in the boiler room for about three hours a day. The hot water temperature must be watched during the summer months and one of the boilers put on or taken off during the heating season.

FULL-AUTOMATIC BURNER HAS SEVERAL ADVANTAGES FOR APARTMENTS

In the writer's opinion, there are many advantages of the semi-automatic burner over the full-automatic burner in apartments. Its first cost is less and it has fewer parts. If these simple controls fail to function the janitor can operate the burner manually without inconvenience to anyone and with few extra trips to the boiler room. When full-automatic controls fail to function the plant must remain idle until a service man can arrive. Except during the early spring and late fall the semi-automatic burner requires little or no attention, but it must be started and turned off by hand in the morning and at night.

HEAVY FUEL CAN BE SUCCESSFULLY BURNED WITH PRESENT EQUIPMENT

No former experience is required nor is any particular skill necessary for the average fireman or janitor to burn No. 6 fuel oil on this type of system. It is possible to successfully fire this grade of fuel, that requires preheating, full-automatically with three or four burners that are manufactured. This is a new development and very few companies that install fuel oil burning systems have sufficient experience or engineering ability at this time to furnish a successful system of this nature even when the physical and operating conditions are ideal.

The life of the boiler combustion chamber and of the boiler, particularly large ones, is shortened if they are frequently chilled and quickly brought up to high temperatures. The full-automatic burner must be set to generate sufficient steam for the most severe weather of the winter and hence the fire from this type of burner will heat up the firebox and boiler rapidly unless the burner is frequently adjusted. A full-automatic burner should only be adjusted by someone thoroughly familiar with every detail of the equipment. During the average winter days the normal fire from a full-automatic burner generates steam pressure or temperature at a rapid rate and the burner is frequently cut off and again started, producing many expansion and contraction strains in the boiler and combustion chamber. To overcome this condition some manufacturers of oil burners will add a semi-automatic control to the full-automatic burner so as to decrease the number of times the burner starts and stops.

MANUAL BURNER MAY BE USED WHERE ATTENDANT IS AVAILABLE

The manual burner has no automatic control to regulate the amount of oil burned. The fire is controlled by hand operated valves at the burner. This type of oil burner is frequently used in large heating plants where it is necessary to have some one in the boiler room on account of high-pressure steam or in the adjoining engine room to take care of ice machines, pumps, compressors, etc.

Oil-Heated Orienta Apartments, Mamaroneck, New York

Fig. 1. Example of Modern Overhead Pan Outlet Type of Supply System as Applied to a Large Department Store Installation

Air Conditioning

by **William Hull Stangle**

VIII—Outlets and Inlets

WE have seen the necessity for the correct selection of fans and their drives as the motive power for the movement of air for both the supply and exhaust (or return) systems, together with the proper design of a balanced distributing system. Elaborate calculations to determine total heat gains, total heat losses, and heat concentration may be nullified by the selection of improperly designed orifices admitting or exhausting air from a given room.

Although a common practice, condition for ordinary ventilation is accomplished when the outlet and the inlet are located as in Fig. 2, such an arrangement may not be possible for all classes of air conditioning. When it is desirable to introduce the air at a temperature just slightly different from that required in the room, the same type (Fig. 2) of distribution will adequately cover air conditioning as well as straight ventilation. However, should it be found advantageous to introduce the air at a low temperature (summer conditions), a better type of distribution is illustrated in Fig. 3.

It has been found that if the air is discharged from the outlet at a great enough velocity it will go to the ceiling, travel toward the opposite wall, drop or diffuse toward the floor, and then return toward the inlet (to be drawn off or recirculated). Great stress must be laid, in such a system, upon the fact that the ceiling should be comparatively smooth to give free air movement.

The system as outlined in Fig. 3 is particularly applicable to rooms having ceiling heights such as are ordinarily encountered in office buildings, and the like, of approximately 10 to 12 ft. When rooms with ceilings of greater height are to be conditioned it is desirable to use overhead pan or rosette supply since comparative temperature differentials may be utilized. Temperature differential may be taken to mean the difference in dry bulb temperature between the entering air and the desired room temperature.

The system which is most universally used is illustrated in Fig. 4. This is applicable for either high or low ceilings when proper account is taken of the temperature differential and the length of blow. One advantage of this system is that the pan or rosette may be fashioned to harmonize with the architectural feature desired.

The system in Fig. 3 is most applicable to areas subdivided into smaller rooms or offices and where it is desirable to maintain a unit system of distribution and control; while the system in Fig. 4 may be used to an advantage in rooms of large area, such as auditoriums.

It is essential when the heat losses are being provided for by the air only that the return or exhaust be located near the floor. For summer cooling it is desirable to place the return or exhaust near the ceiling. Where heat losses are amply provided for by direct radiation the exhaust inlet may be located near the ceiling.

Sizes of outlets are determined by the volume, length of flow, ceiling height, and permissible maximum noise level. It is considered good practice to limit the quantity or volume of air supplied in office build-

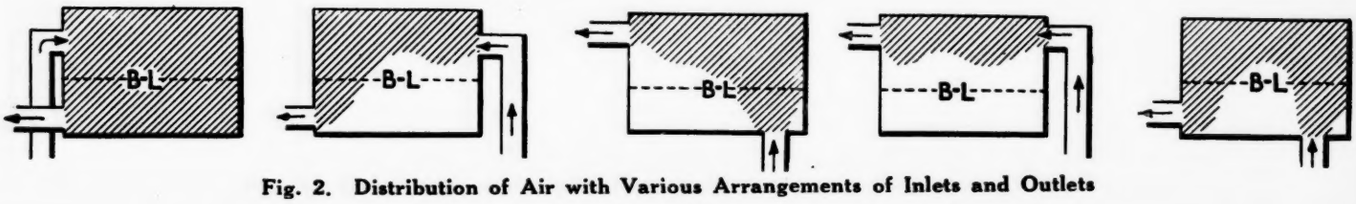


Fig. 2. Distribution of Air with Various Arrangements of Inlets and Outlets

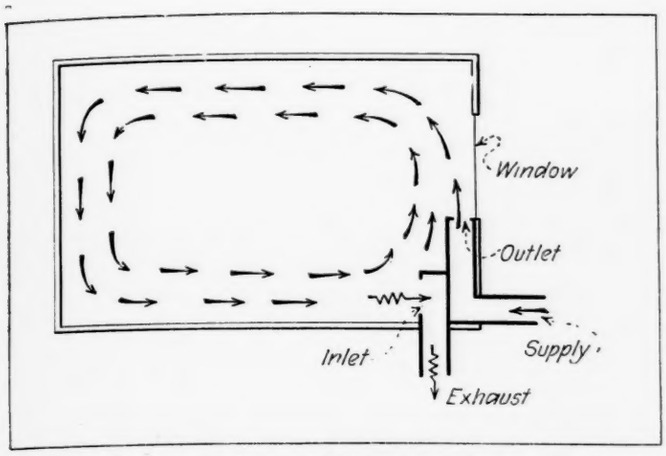


Fig. 3. Recommended Distribution for Air at Low Temperature

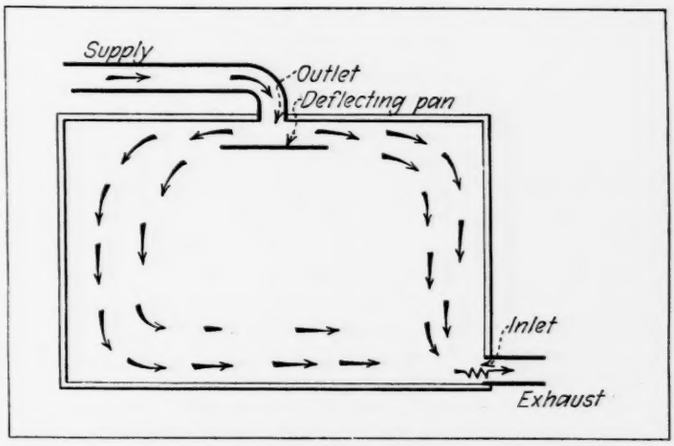


Fig. 4. Distribution System Universally Used. Applicable for Both High and Low Ceilings

ings or the like to about 1000 c.f.m. per outlet. The length of blow is a function of the velocity of emission from the outlet. Velocities are governed by the physical conditions that would produce injurious drafts, and are usually limited to between 200 to 500 ft. per min. over the *net* area of the outlet. The lower limit applies to low ceilings and short blows, while the higher velocities apply to higher ceilings and longer blows.

Sizes of inlets are determined by the volume and permissible entering velocity, the latter relating to possibility of drafts and objectionable noise. Common practice is to size exhaust or return openings located at the ceiling by using velocities ranging from 200 to 400 ft. per min. When return or exhaust inlets are located near the floor or below the breathing line, where pronounced breeze would be objectionable to the occupants, it is well to keep the velocities lower, say from 125 to 175 ft. per min.

The length of blow from outlets is affected by the temperature differential between entering air and the air in the room. When warm air is emitted into a colder room it will rapidly rise, materially shortening the effective blow; when cool air is emitted into a warmer room it will rapidly drop, also materially shortening the effective blow, and when the entering air is introduced into a room of practically the same temperature it will have a decided tendency to continue in the direction of blow, being effected solely by the force of gravity and thereby resulting in a longer effective blow.

The actual design of an outlet is determined by the proper application of the laws of hydraulics since air is a gaseous fluid, and within limits, follows the physical laws concomitant to water, which is a liquid fluid, and these laws, for practical purposes, may reasonably be followed in

Fig. 5. A Typical View of Side Outlet Used in Connection with Humidifying System of a Cotton Mill

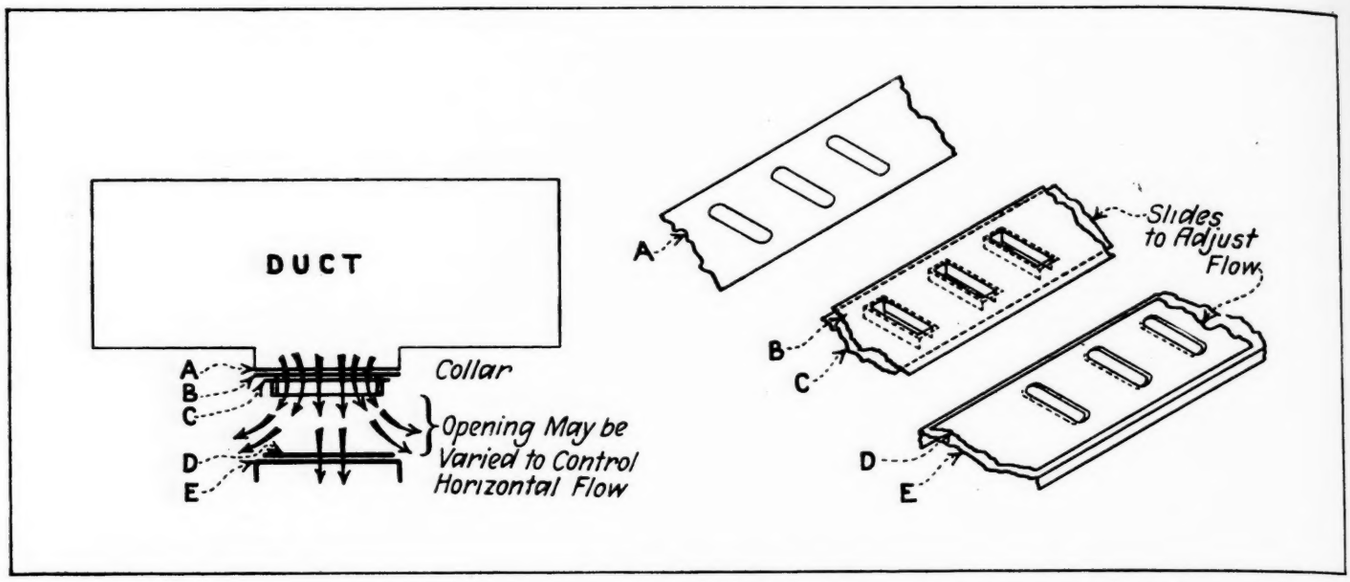


Fig. 6. Detail of Special Outlet Shown Below. Both Horizontal and Vertical Distribution Can Be Controlled

the distribution of air.

The accepted formula for the quantity of air discharged from an orifice (outlet) in cubic feet of air per minute is

$$Q = 1096.5\ C_c C_v A \sqrt{\frac{p}{w}}$$

$$= 1096.5\ CA \sqrt{\frac{p}{w}}$$

Q = discharge in cubic feet of air per minute.
A = area of orifice (outlet) in square feet (net).
p = pressure head in inches of water.
w = weight of air in pounds per cubic foot.
C_c = Coefficient of contraction.
C_v = Coefficient of velocity.
C = C_c times C_v = coefficient of discharge.

The coefficients C_c, C_v and C, which are determined experimentally, are shown in Table I and refer to orifices of types illustrated in *Fan Engineering*.

TABLE I.—VALUES OF COEFFICIENTS

Orifice	C_c	C_v	C
Sharp Edge	0.62	0.98	0.60
Round Edge		0.98	0.98
Short Pipe			0.82
Reentrant			0.72
Converging			*

*(See *Fan Engineering*, page 61, *et seq.*)

With proper care the outlets and inlets may be designed to produce a balanced distribution of air into and from a room. Probably the most desirable system would be one wherein the outlets were numerous small apertures in the ceiling from which the air could be evenly disseminated to all parts of the enclosure within uniform low velocity.

This would lead to quiet operation, constant volume, even diffusion, and slight effective temperature variation, in all—"distribution optimo."

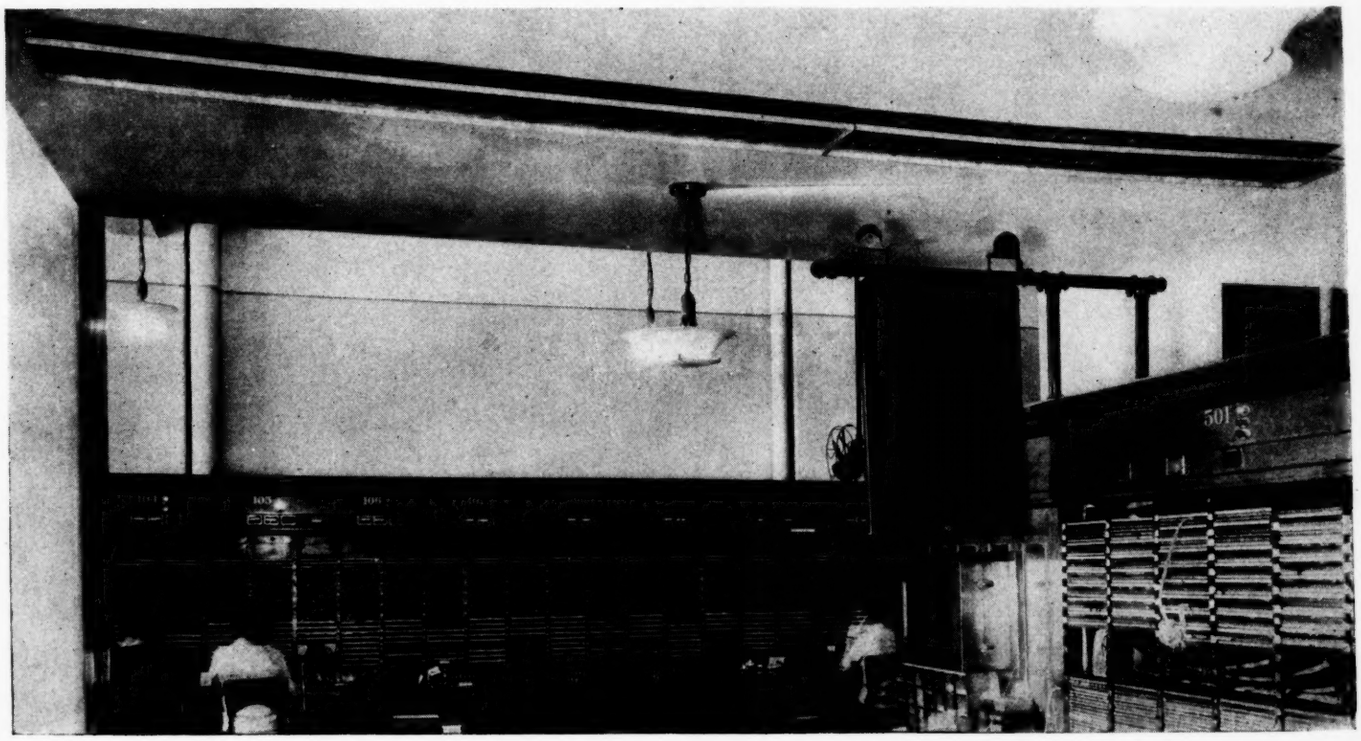


Fig. 7. Special Outlet Installed in a New York Telephone Building

Choosing the Thickness of Insulation for Oil Heated Buildings

by **Paul D. Close**

In the August and October, 1930 issues, Mr. Close presented formulae for estimating the proper thickness of building insulation. He presented a graphical solution of the problem when using coal fuel. In this issue the author discusses the same subject when the heating system is oil fired and presents a graphical solution of the problem.

Attention is called to the fact that the graphical solution can be used without reference to the derivation of the formulae.

IN previous issues the writer presented formulae, together with the derivation thereof, for estimating the thickness of insulation required for building construction.

Formula A was intended to be used when the fuel saving only is considered, and was based on the return on the investment for the overall thickness of insulation. Formula B was similar to Formula A, except that the thickness of insulation obtained was based on the return on the investment of the final increment of thickness. Either formula may be used for estimating the insulation thickness, but a lower return on the investment should be used in Formula B than in Formula A, due to the fact that the instantaneous return for the final thickness is considered in Formula B and the return for the overall thickness is considered in Formula A. Although the latter formula is recommended for general use, either may be used with satisfactory results if the return on the investment is properly considered.

DERIVATION OF FORMULA FOR OIL

The derivation of the formula for determining the proper thickness of insulation for oil fuel is similar to that for coal. The fuel saving (F_o) in gallons of oil per heating season, *for one square foot of wall or roof area*, may be estimated from the following formula:

$$F_o = \frac{(U - U_1) \times N \times (t - t_a)}{C_c \times E_o \times W} \qquad (24)$$

where

C_o = calorific value of oil, B.t.u. per lb.
E_o = overall heating efficiency for oil—per cent (expressed as a decimal)
W = pounds of oil per gallon.

The other symbols are as previously defined.

The return on the insulation investment for oil is obtained from the following formula:

$$r = \frac{100 \times F_o \times p}{Y_o \times z} \qquad (25)$$

where

p = cost of oil, cents per gallon
Y_o = required thickness of insulation for oil fuel, inches

$$U_1 = \frac{1}{\frac{1}{U} + \frac{Y_o}{k}} \qquad (26)$$

From equations (24), (25) and (26),

$$Y_o = \frac{100 \times p \times U \times N \times (t - t_a)}{r \times z \times C_o \times E_o \times W} - \frac{k}{U} \qquad (27)$$

In equation (27), assume that $N = 5040$, $C_o \times W = 141{,}000$, and $E_o = 0.70$. Therefore,

$$Y_o = \frac{5.11 \times p \times U \times (t - t_a)}{r \times z} - \frac{k}{U} \qquad \text{(Formula E)}$$

An example will serve to illustrate the use of Formula E. The thickness of insulation for a 6-in. concrete roof with a suspended metal lath and plaster ceiling is required for the following conditions: cost of oil per gallon (p), 11 cents; average outside temperature during heating season (t_a), 40° F.; inside temperature near roof (t), 70°; desired overall return on the investment (r), 20%; installed cost of insulation per inch thickness (z), 12 cents; conductivity of insulation per inch thickness (k), 0.35; coefficient of transmission (U) of roof, 0.309 (See Table 30, page 66, A.S.H.V.E. *Guide*, 1931). Substituting these values in Formula E:

$$Y_o = \frac{5.11 \times 11 \times 0.309 \times (70 - 40)}{20 \times 12} - \frac{0.35}{0.309} = 1.04 \text{ in.}$$

Since the nearest commercial thickness in this case would be 1 in., the return on the investment for this thickness would be 20.4% which, of course, is obtained by substituting in Formula E and solving for r.

CHART FOR ESTIMATING INSULATION THICKNESS

In many cases a graphical solution of the problem is more convenient than the formula solution. Fig. 8 may be used in place of Formula E for determining the proper thickness of insulation when oil is the fuel used and is based on an overall return on the insulation investment of 20%, a heating season of 210 days or 5040 hours, a heating efficiency of 70% and oil having a calorific value of 141,000 B.t.u. per gal. The solution of a typical problem is indicated on Fig. 8 by the dotted lines which should be drawn in the order indicated by the numbers. The procedure is as follows:

1. Locate the cost of oil per gallon on Scale A, and draw a line horizontally to the right.

2. Find the average inside-outside temperature difference on Scale B, and draw a line to point P. (See Table 1, October, 1930.) The inside temperature should

be near the wall or roof surface, as the case may be. The outside temperature should be the average for the months of October to April, inclusive, since the chart is based on this period of time.

3. From the intersection of lines 1 and 2, draw a line vertically downward.

4. Locate the cost of the insulation (per square foot per inch thickness, installed) on Scale C and draw a line until it intersects with line 3.

5. From the intersection of lines 3 and 4, draw a line to point P.

6. At the intersection of line 5 with line MM, draw a line vertically downward.

7. Locate the coefficient of transmission of the uninsulated wall or roof on Scale D and draw a line to point Q.

8. From the intersection of lines 6 and 7, draw a line horizontally to the left to Scale E, on which will be indicated the gross thickness of insulation required.

9. Next, locate the coefficient of transmission of the uninsulated wall or roof on Scale F, and draw a line vertically upward.

10. Then, locate the conductivity of the insulation on Scale G and draw a line horizontally to the right.

11. Draw a line from point R, through the intersection of lines 9 and 10, to Scale H.

12. The correct thickness of insulation is obtained by subtracting the thickness indicated on Scale H from the thickness indicated on Scale F.

INSTANTANEOUS RETURN ON FINAL INCREMENT

As in the case of coal, an alternate method is presented herewith for determining the thickness of insulation for oil fuel on the basis of the return on the investment for the final increment of thickness. In other words, instead of basing the estimated thickness on the return for the overall thickness of insulation, the governing factor will in this case be some limiting value of the instantaneous return for the final increment of thickness.

The following formula may be used for this purpose:

$$Y_0 = k \times \sqrt{\frac{5.11 \times p \times (t - t_a)}{k \times z \times I_r}} - \frac{k}{U} \qquad \text{(Formula F)}$$

For any given set of conditions, the instantaneous return on the investment for the final increment of thickness will decrease as the thickness increases. Consequently, for the same thickness of insulation the overall return on the investment (r) as used in Formula E will be higher than the instantaneous return (I_r) on the investment for the final increment of thickness. The relation between the instantaneous return and the overall return is given by the following formula:

$$I_r = \frac{r^2 \times k \times z}{5.11 \times p \times (t - t_a) \times U^2} \qquad \text{(Formula G)}$$

In the example cited earlier in this article, it was found that the return on the investment (r) was 20.4% for a 1-in. thickness of insulation. Substituting the figures used in this example in Formula G, the instantaneous return on the investment for the final increment of thickness (at 1 in.) is found to be:

$$I_r = \frac{(20.4)^2 \times 0.35 \times 12}{5.11 \times 11 \times (70-40) \times (0.309)^2} = 10.8\%$$

If the desired limiting value of the instantaneous return on the investment were say 8%, the thickness of insulation required would be determined by means of Formula F as follows:

$$Y_0 = 0.35 \sqrt{\frac{5.11 \times 11 \times (70 - 40)}{0.35 \times 12 \times 8}} - \frac{0.35}{0.309} = 1.34 \text{ in.}$$

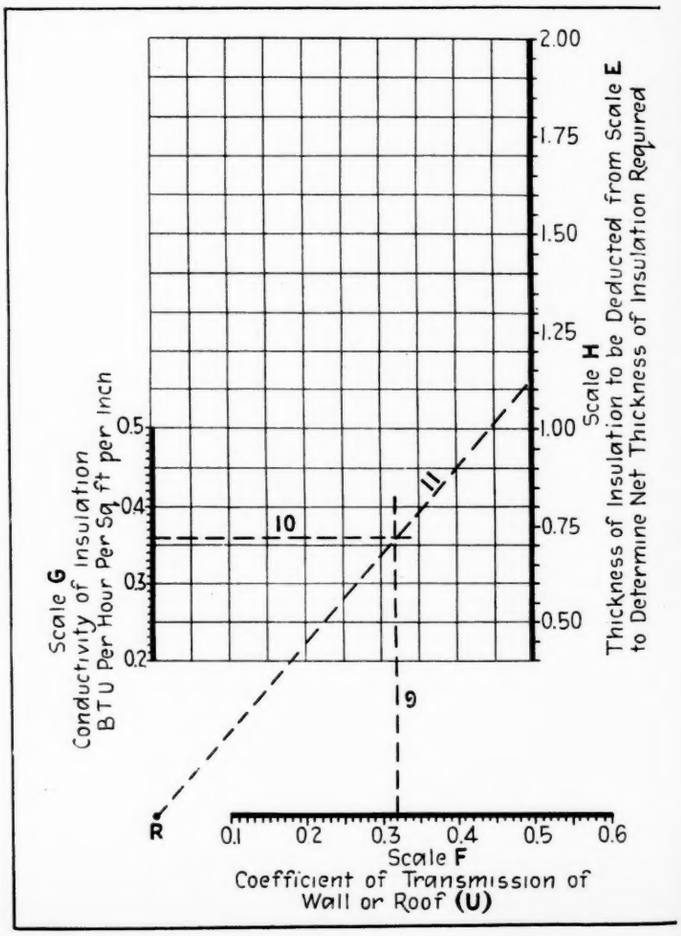
As previously stated, either Formula E or Formula F may be used for estimating the thickness of insulation to use for oil fuel, provided the proper return on the investment is used, the overall value for the full thickness being used in the case of Formula E and the instantaneous value for the final increment being used in the case of Formula F. It is the writer's opinion that Formula E is the more practical for general use.

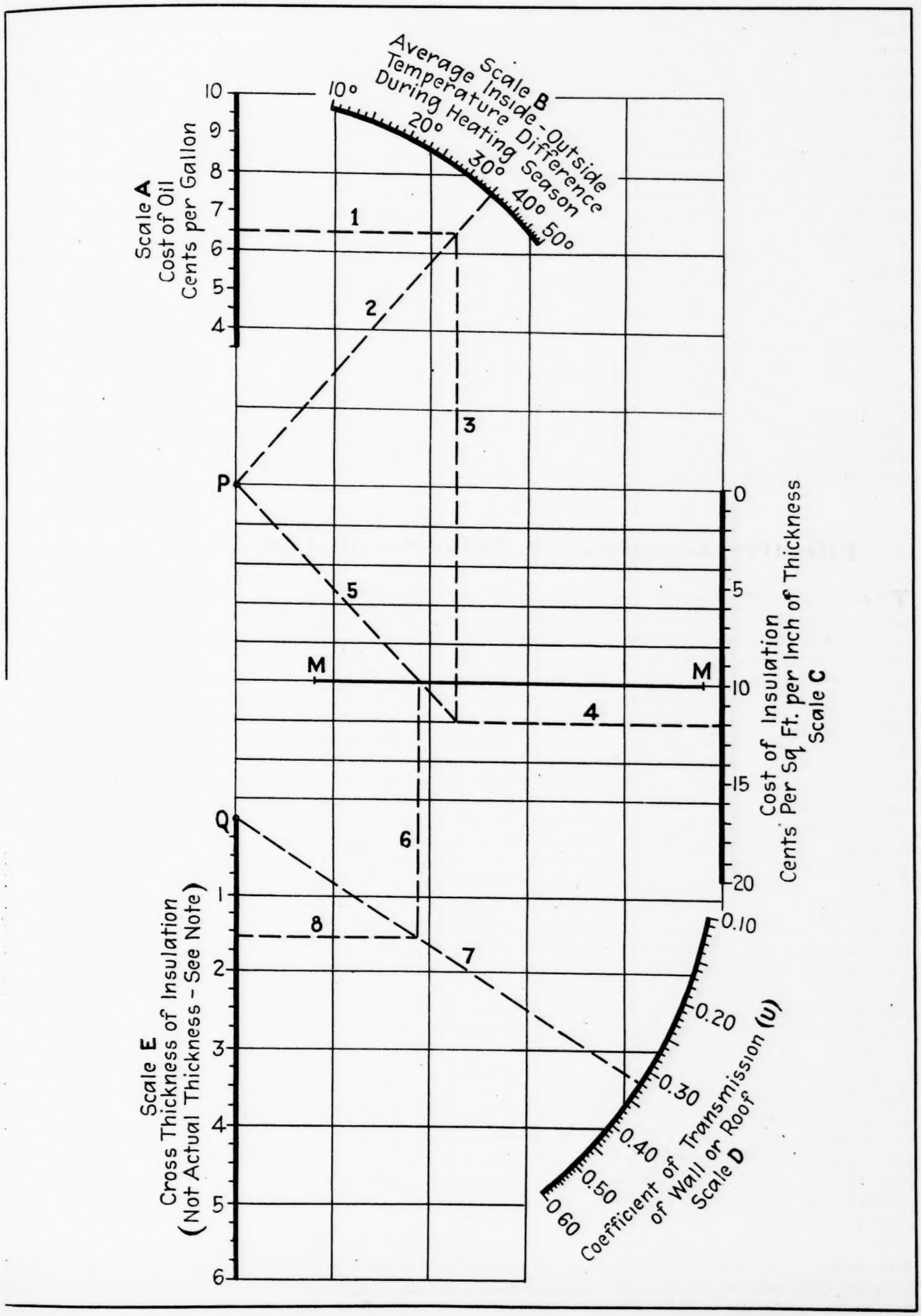
INSULATION THICKNESS BASED ON FUEL AND RADIATION

If direct radiation is installed in a building and allowance is made for the saving in radiation made possible by the application of insulation to the walls and/or roof, the thickness of insulation based on any given return on the investment will be greater than for the same return on the investment when only the fuel saving is considered. This is because the monetary value of the radiation saving is deductable from the

Fig. 8. Charts for Estimating Thickness of Insulation for Oil Heated Buildings

Note: The Actual Thickness of Insulation is Obtained by Subtracting the Thickness Obtained from Scale H, from the Thickness Obtained from Scale E. Dotted Line Indicates Solution of Typical Problem. Draw Lines in the Order Indicated by Numbers.




Scale A
Cost of Oil
Cents per Gallon
10
9
8
7
6
5
4
Scale B
Average Inside - Outside
Temperature Difference
During Heating Season
10°
20°
30°
40°
50°
1
2
3
P
5
M
M
4
Q
6
8
7
Scale C
Cost of Insulation
Cents Per Sq. Ft. per Inch of Thickness
0
5
10
15
20
Scale D
Coefficient of Transmission (U)
of Wall or Roof
0.10
0.20
0.30
0.40
0.50
0.60
Scale E
Cross Thickness of Insulation
(Not Actual Thickness - See Note)
1
2
3
4
5
6

cost of the insulation, making the net cost for any specified thickness less than when radiation is not considered. Since the net cost is less, the return due to the fuel saving will be greater, and therefore an additional thickness of insulation will be required to reduce the return on the investment to the same percentage, e.g. 20%, as when the fuel saving only is considered.

The derivation of the formulae for estimating the thickness of insulation required when both the fuel and radiation savings are considered, is similar to that for fuel only. The formula for oil fuel and steam radiation is as follows:

Y_{os} = thickness of insulation for oil and steam radiation, inches

$$= \frac{5.11 \times p \times (t - t_a) \times U + 0.417 \times (t - t_o) \times r \times s \times U}{r \times z} - \frac{k}{U}$$

(Formula H)

where

s = monetary value of saving in steam radiation, dollars per square foot

t_o = outside temperature on which the design of the heating system is based

If in the example originally cited in this article an allowance is made for the possible reduction in the required amount of direct radiation on the basis of 50 cents per square foot, and if a steam heating system is installed, the thickness of insulation required for an overall return on the investment of 20% and for an outside temperature (t_o) of zero will be:

$$Y_{os} = \frac{5.11 \times 11 \times (70-40) \times 0.309 + 0.417 \times (70-0) \times 20 \times 0.50 \times 0.309}{20 \times 12} - \frac{0.35}{0.309} = 1.41 \text{ in.}$$

Therefore, by making allowance for the possible reduction in steam radiation valued at 50 cents per square foot, the required insulation thickness increased from 1.04 in. to 1.41 in., for the same overall return on the investment (r) of 20% in the two cases.

The formula for oil fuel and a hot water system, where allowance is made for the possible reduction in radiation is as follows:

V_{oh} = thickness of insulation for oil and hot water radiation, inches

$$= \frac{5.11 \times p \times (t - t_a) \times U + 0.625 \times (t - t_o) \times r \times h \times U}{r \times z} - \frac{k}{U}$$

(Formula I)

where

h = monetary value of saving in hot water radiation, dollars per square foot

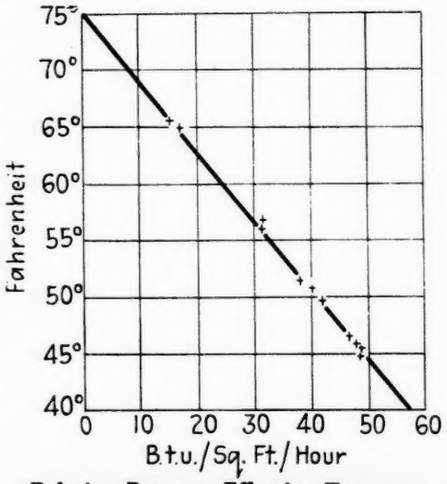
If the same example is again used, the thickness of insulation for a radiation value of 50 cents per square foot for a hot water system will be 1.6 in.

Effective Temperature Being Studied in Great Britain

THE report of the Building Research Board for 1929, published through His Majesty's Stationery Office, contains some results of the work at the Experimental House of a rather fundamental nature in the heating of the building. This work has been under way for several years and some of the instruments and methods developed are both interesting and unique.

Use of the Kata thermometer has occupied a prominent position in British work on heating. A new form of this thermometer is illustrated and described in the above report. It is specially constructed, the bulb being made of copper with a very thin lining of glass (0.4 mm.), and is filled with mercury. The report states that this construction insures that the surface is at the same temperature as the thermometric liquid. The thermometer is used to measure the effective temperature of a room and the report states that in a comfortably warmed room it takes one minute to cool the thermometer from 75½° F. to 74½° F. The work assumes that the effective temperature of an environment may be defined as that temperature of a uniform enclosure in which, in still air, a sizable black body at 75° F. loses heat at the same rate as in the environment. British experimenters set the rate of heat loss for comfortably warm conditions at 17.5 B.t.u. per sq. ft. per hr. from the black body.

A measuring instrument based on this theory and placed in a room in which the air and walls were maintained at the same temperature yielded results shown in the accompanying chart. It will be noted that the effective temperature corresponding to 17.5 B.t.u. per sq. ft. per hr. is 64.3° F. Since the time required to cool the Kata from 75½° to 74½° was found to be one minute, a simple and convenient method of reading effective temperatures was possible. A stop-watch face was calibrated in terms of these temperatures with 64.3° at the zero and one minute point. Observation of the cooling time of the Kata could thus be read directly in effective temperatures.



Relation Between Effective Temperature and Heat Loss from a Body

Studies are under way to investigate the influence of the fabric of walls upon the rate of warming of rooms with various methods of heating and the report contains some data showing how slowly a plastered 9-in. brick wall of a small furnished room heats up.

Instruments have also been devised and calibrated for measuring the flow of heat across the surface of a wall which are stated to be simpler than those previously used. These instruments are designed to measure radiation and convection separately. Both instruments make use of thermo-electric methods.

The radiation instrument consists of a thermopile made up with tinfoil sheets inserted into the circuit and with these surfaces so arranged that each is equally affected by convection but are unequally heated by radiant heat. The convection instrument consists of fine wire couples, one set of which is put against the wall surface and another at 5.0 mm. from it. This difference in temperature may be calibrated in terms of convective heat flow.

Estimating and Designing Heating Systems

XV—Conclusion

by **Fred W. Hanburger***

THOSE of our readers who have been following Mr. Hanburger's excellent course, of which this is the concluding installment, will be interested in learning that the material which has appeared, together with additional technical data pertaining to the design of heating and ventilating systems, will be published in book form in the near future. Announcement of the publication of the book will appear in HEATING AND VENTILATING *as soon as the book is off the press.*

We are pleased to announce that Mr. Hanburger will continue his association with HEATING AND VENTILATING *and its readers through a special department which will be announced shortly.*

WHEN, due to an unbalanced friction loss, a gravity water heating system fails to function properly, resort is sometimes made to use of accelerating pumps. When so applied they are often called boosters, but this term is rather an implication that their purpose is but an adjunct to a poorly designed system. With their use we may always expect an improvement in the circulation in a sluggish area but it is too much to expect that they will entirely cure all the evils in a faulty installation that has been designed for gravity circulation. This has led to an apathy on the part of some towards a very meritorious article. To secure best results from accelerating pumps the system should be designed to meet their needs. Anomalous though it may seem, they will often give greater correction to an extremely unbalanced gravity system than to one that is fairly balanced but with a few slightly sluggish areas.

It is sometimes confusing as to the method of investigating an existing poorly functioning system to determine where the errors lie and what corrections should be made. Fig. 35 represents a gravity hot water heating installation for a three-story building where the circulation in general was found to be erratic, and with no circulation whatever to radiator R in moderately cold weather. To simplify the discussion somewhat the radiation to each room has been taken at 90 sq. ft. of cast iron water radiation, and the distance from the boiler to riser No. 2 at 20 ft. measured length. The distance between each set of risers is also taken at 20 ft. The power generating heights to the first, second and third floors are 6, 16 and 26 ft. respectively. The power generated by the radiators on the various floors with a temperature drop of 30° is then

$$\begin{aligned} 6 \text{ ft.} \times 0.63 \text{ lb.} &= 3.78 \text{ lb. per sq. ft.} \\ 16 \text{ ft.} \times 0.63 \text{ lb.} &= 10.08 \text{ lb. per sq. ft.} \\ 26 \text{ ft.} \times 0.63 \text{ lb.} &= 16.38 \text{ lb. per sq. ft.} \end{aligned}$$

for the first, second and third floors, respectively. For a temperature drop of 20° the power would be 2/3 of these amounts and for a 40° drop it would be 4/3 that for 30°.

Referring to the method of designing described in the second article of this series,† the friction loss to the various radiators for temperature drops of 20°, 30° and 40° was found to determine at which stage the system was at its best balance. This was found to be for 30° and the total friction loss from the boiler to and through the radiator and return to the boiler is marked at each radiator as calculated on this basis. The student should check these results for the purpose of review.

It will now be noted that the friction loss to radiator P on riser No. 6 is 3.98 lb. per sq. ft. against a developed power of 3.78 lb., which is a fairly close approximation. To radiator O it is 8.90 lb. against a required 10.08 lb., and to radiator N we have 12.74 lb. per sq. ft. of friction loss against 16.38 lb. of developed power.

The upper radiators on this riser are thus seen to be favored but not to such an extent that it can not be overcome by the compensating nature of a gravity hot water heating system or to seriously affect the supply to the other radiators.

To radiator R, however, the friction is found to be 6.6 lb. per sq. ft. against a developed power of 3.78 lb. per sq. ft. for a 30° drop in temperature. The water, therefore, will be held in the radiator until it has cooled sufficiently to create the added power. There are too many ramifications to the problem to exactly determine what the temperature of the return will be from this radiator, but a better viewpoint and a clearer conception of the problem may be obtained by a further investigation.

To have the same amount of water flowing as that for a 30° drop and creating 6.6 lb. per sq. ft. of friction loss the radiator must develop this same amount of power with its 6 ft. of height. This would require an increased weight of water in the return of

$$\frac{6.6 \text{ lb.}}{6 \text{ ft.}} = 1.1 \text{ lb. for each foot of height.}$$

That is, the weight of a cubic foot of return water must be 1.1 lb. greater than a cubic foot of the supply. Roughly, we may take 0.021 lb. increase in weight for each degree of temperature decrease. It would then require a drop in temperature in radiator R of

$$\frac{1.1 \text{ lb.}}{0.021 \text{ lb.}} = 53°$$

to develop this power. This would be the case only if the return from the radiator would run direct to the

*Special Lecturer on Heating and Ventilation, College of the City of New York.

†*Heating and Ventilating, December,* 1929.

boiler and it would have the advantage of the full 6 ft. of colder column. It, however, does not do this but mixes with the return water from the other radiators and adds its accelerating effect to the other radiators at the expense of radiator R. The temperature drop in R will then be greater than the 53°, and on moderately cool days, when a temperature of about 140° is sufficient for the balance of the system, the water in R will not be much above room temperature. In the actual installation the 1¼-in. branch to radiator R was replaced with 2-in. pipe and 1½-in. radiator connections.

The third floor radiator M, the only radiator on riser No. 1, was supplied with a 1¼-in. pipe which creates but about 3 lb. per sq. ft. of friction against a power of 16.38 lb. This radiator was always the first to warm up and its room was continually overheated. Instead of changing the piping to this radiator to a smaller size a lock shield gate valve was inserted at A and set so that the required amount of friction was produced.

In all the intermediate risers the same size pipe and radiator connections were used as in riser No. 6, i.e., 1 in. to the third and 1¼ in. to the first and second floors. It will be noted that the risers nearest the boiler were the most favored. To overcome this, lock shield gate valves were also used at points B, C, D and E. The gate valves were all permanently set at the time of initial firing by opening or closing them sufficiently so that all the risers warmed evenly and at approximately the same time. The more common practice is to try and 'ease' the circulation to ill-favored areas with the use of one-eighth bends and take the supply from the top of mains, etc.

Possibly the better practice is to throttle or restrict the favored sections and thus force the circulation to the less favored places. Instead of coaxing it is best to use force, and make it go where we want it.

By still further closing the throttling valves the circulation could have been forced to radiator R without enlarging the pipe to this radiator, but the friction loss was so large to this radiator that the entire system would need to operate on a temperature drop of over 50° F., which is rather excessive for good practice.

Let us now note the effect if instead of making any pipe changes an accelerating pump had been placed at the point G. As we know, in a gravity system each radiator develops its own power and the friction to, through and from the radiator must be made equal to this amount. The higher radiators with their greater power need increased throttling. Thus a 1-in. pipe is more than sufficient to supply 90 sq. ft. of radiation to the third floor radiators in Fig. 34 while a 2-in. pipe is needed to supply the same amount of radiation to radiator R.

With forced circulation the force generated by the different radiators is no longer a factor and all that need be considered is the force created by the pump itself and this same force is exerted on every radiator. Therefore, the friction from the pump to and through each radiator and the return to the pump must be the same for each radiator, and in the case of the risers the lower floor radiators should have the smaller connections. In Fig. 35 the friction to R which was the least favored, is but about half that to radiator N, and R would now heat long before N. Again the friction to M is still less than it is to R, and M would still heat before R. Thus by supplying sufficient power to the pump we could positively force sufficient circulation to

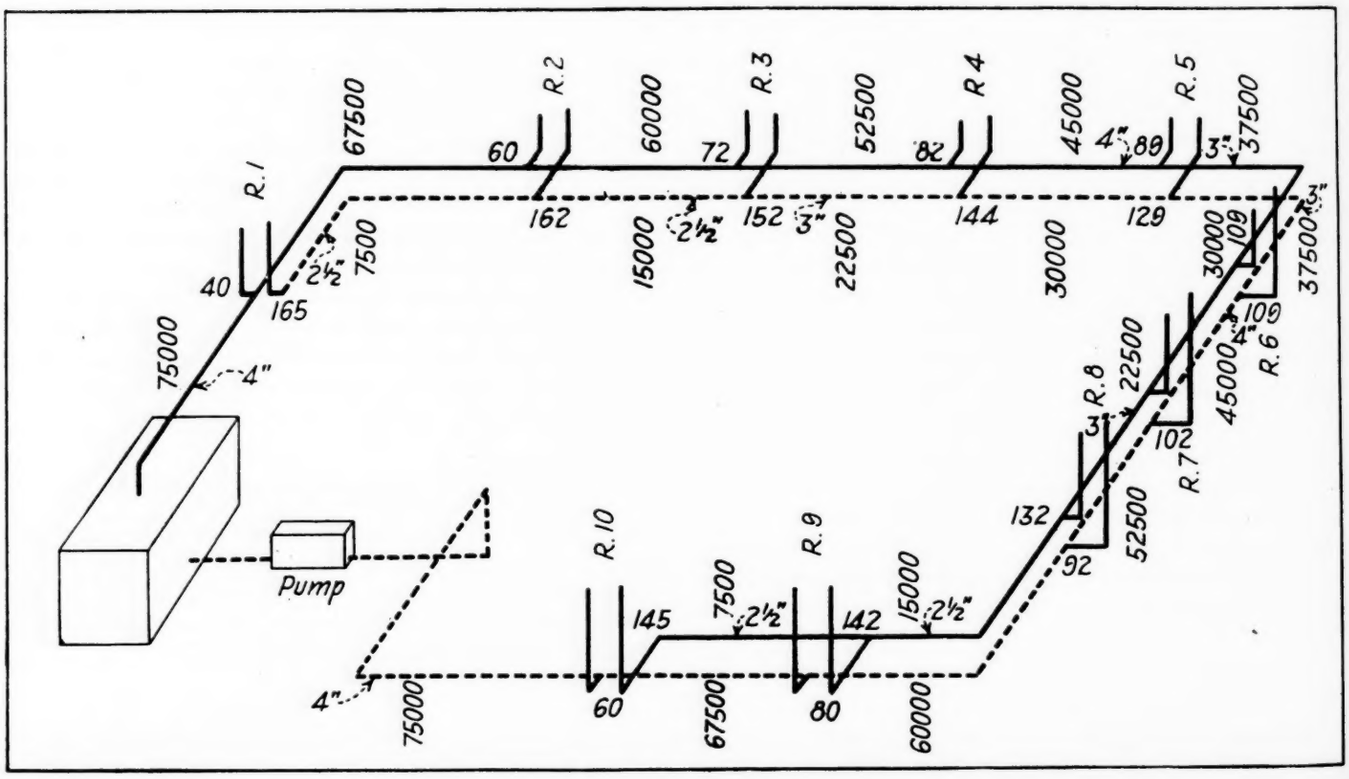


Fig. 34. Layout for Forced Hot Water System

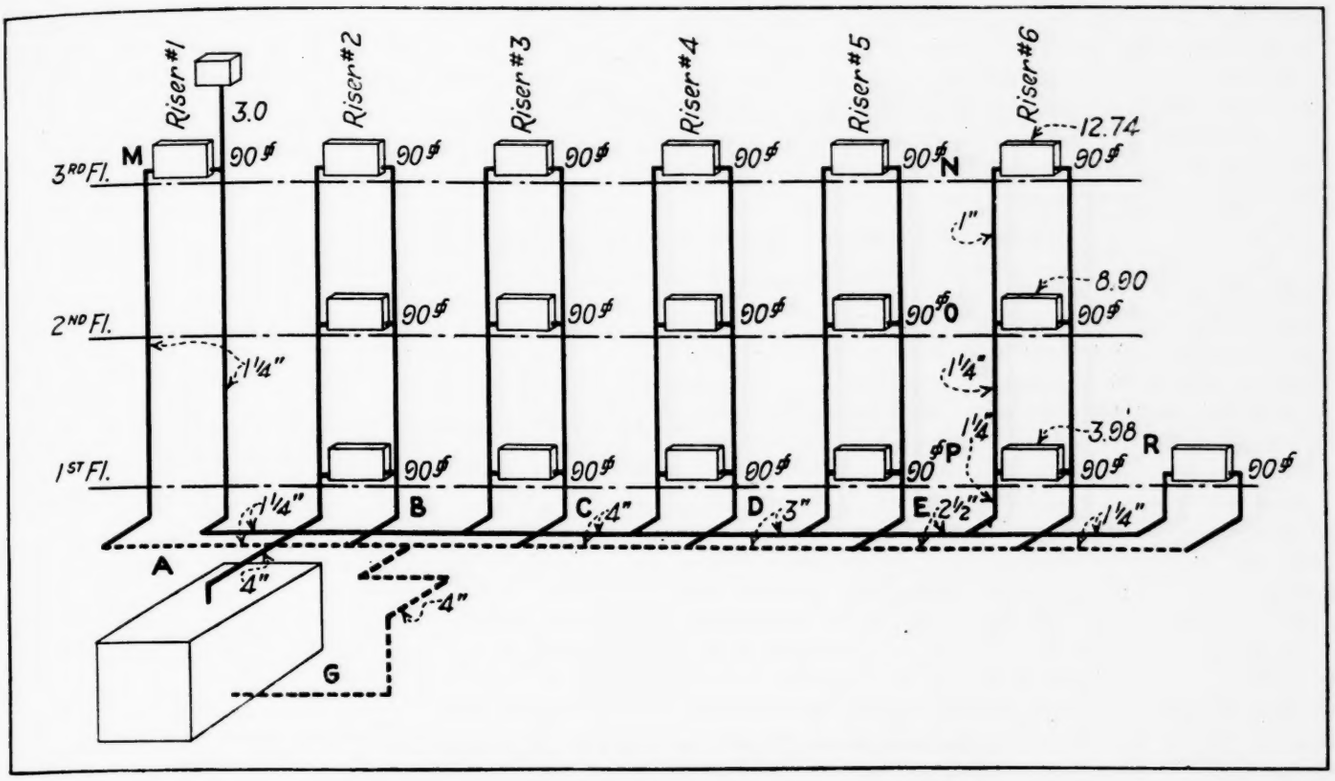


Fig. 35. Gravity Hot Water System for Three-Story Building

all parts of the system, but some sections would perforce receive more than needed.

Fig. 34 is a layout for a forced hot water two-pipe main system for a 10-story building with 10 risers supplying 50 sq. ft. of radiation to each floor. The distance from the pump to the first riser is taken as of 40 ft. of equivalent pipe, with 20 equivalent feet between each set of risers and 60 equivalent feet from the last riser to the pump.

In designing a system of this kind it is possible to preserve a perfect balance throughout, but in an extended system it results in such a multiplicity of reducers and pipe changes that confusion is apt to result in its installation. It is best then to keep our layout as simple as possible and still keep within the bounds of good working design.

Due to this fact a reversed flow has been used and it will be noted that the return from riser No. 1, instead of returning by a short circuit to the boiler or pump, is carried to and with the return from the succeeding risers. Thus the circuit for all risers is practically of the same length and the resulting friction for each is nearly equal.

In the choice of the temperature drop to be used we must be governed

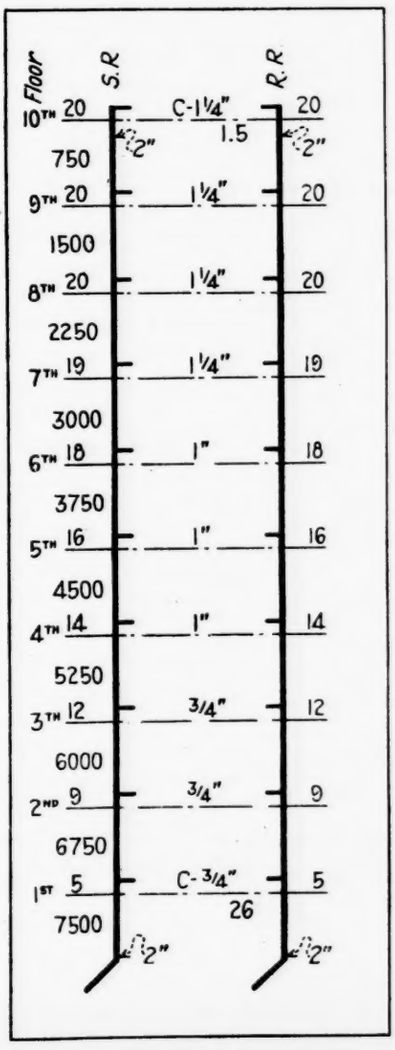


Fig. 36. Riser Diagram

by the resulting radiator connections necessary for the lower radiators rather than those of the upper ones as in gravity heating. With this amount of radiation and for a 10-story building we will have found that the connections for the lower floor shall have reduced to ¾ in with a temperature drop of 10° between the water entering and leaving the radiator and this drop is adopted in the design.

Fig. 36 shows a typical riser for the system, giving the amount of water flowing through each section. With a radiator emission of 150 B.t.u. and for a 10° temperature drop there will be

$$\frac{150 \text{ B.t.u.}}{10} = 15 \text{ lb. of water for each sq. ft. of radiation,}$$

or 750 lb. for each radiator.

The friction loss through each section is estimated and the total from the foot of the riser to each floor is marked in underscored figures on both the supply and return risers. Thus the total friction in both risers to the 10th floor radiator is 40 lb. per sq. ft. and to the first floor is 10 lb. per sq. ft.

However, the friction loss to and through each radiator should be the same and the balance will need be made up in the connections to the

radiators. Referring to the flow chart we find that a 1¼-in. connection gives but a loss of about 1.5 lb. per sq. ft. for 750 lb. of water and for about 20 ft. of equivalent pipe, which would prevail in making the connection. Adopting this size for the upper radiator gives a total loss of 41.5 lb. per sq. ft. The connection to the lower radiator should now be made to produce

$$41.5 \text{ lb.} - 10 \text{ lb.} = 31.5 \text{ lb.}$$

From the chart it is found that the loss through a ½-in. connection would be excessive and a ¾-in. connection giving a loss of about 20 lb. per sq. ft. has been adopted, leaving an unbalanced condition of 10 lb. As we shall see later when the riser friction has been added to that of the mains this discrepancy will not be excessive.

A closer balance could be obtained if 2½-in. pipe were used for the risers, but the slight advantage gained does not justify the expense and unsightliness of the larger pipe. The remaining connections between the first and tenth floors can be graded in by inspection.

In sizing the mains we are not severely limited and it depends more on our choice of the velocity of flow we may desire to use. In central heating plants velocities of 10 ft. per sec. are often employed. This is rather high for a private installation and a velocity of 4 ft. per sec. has been selected for this installation.

Referring to the flow chart it is found that a 4-in. pipe will deliver the 75,000 lb. of water at this velocity with a resulting friction loss of 1 lb. per sq. ft. per lin. ft. The amounts of water flowing through the various sections of the mains are marked in Fig. 34 and the size of the pipe to be used for the sections can be taken directly from the chart by adhering to an approximate velocity of 4 ft. per sec. We thus find the supply main reducing and the return main increasing as we move forward along the system.

The friction losses are now estimated for each section and the total from the pump along the supply main to the foot of each supply riser is marked in underscored figures. Similarly, the total friction from the pump backward along the return main is shown at the foot of each return riser. By adding the friction losses at the foot of each set of risers it is found that in all cases except the first and last, the loss is about the same, an average of about 222 lb. per sq. ft. The first and last sets could be still further throttled but the variation is only about 8% which would mean a flow of $\sqrt{1.08} = 1.04$ above the required amount, an increase of 4%.

The load on the pump will be the sum of the loss through the mains, risers and radiators or approximately

$$222 \text{ lb.} + 42 \text{ lb.} = 264 \text{ lb. per sq. ft.}$$

which reduces to

$$\frac{264 \text{ lb.}}{144 \text{ sq. in.}} = 1.8 \text{ lb. per sq. in.}$$

The necessary horsepower can readily be ascertained by taking the velocity and friction through any section of the piping. Thus through the 4-in. pipe we have a velocity of 4 ft. per sec. or 240 ft. per min. under a pressure of 1.8 lb. per sq. in. The sectional area of the 4-in. pipe is

$$4^2 \times 0.7854 = 12.6 \text{ sq. in.}$$

The total pressure on a cross section area is then

$$12.6 \text{ sq. in.} \times 1.8 \text{ lb.} = 22.68 \text{ lb.}$$

The foot-pounds per minute will then be

$$22.68 \text{ lb.} \times 240 \text{ ft.} = 5443 \text{ ft.-lb. per min.,}$$

and the theoretical horsepower is

$$\frac{5443 \text{ ft.-lb.}}{33{,}000 \text{ ft.-lb. per hp.}} = 0.165 \text{ hp.}$$

Allowing an efficiency of 50% we have an actual hp. of 0.33. The manufacturer's ratings are usually given in gallons delivered per minute and the horsepower per foot of head. In this case we have

$$\frac{75{,}000 \text{ lb. per hr.}}{8.3 \text{ lb.} \times 60 \text{ min.}} = 150 \text{ gal. per min.}$$

The friction loss of 1.8 lb. per sq. in. is the only head against which the pump is working and this represents a head of

$$\frac{1.8 \text{ lb.}}{0.434 \text{ lb.}} = 4.1 \text{ ft. of water column.}$$

This would give a horsepower of

$$\frac{0.33 \text{ hp.}}{4.1 \text{ ft.}} = 0.08 \text{ hp. per ft.}$$

of head and the pump would be so rated. On this basis the proper selection can then be made.

It will be noted that this is a ten-story building with a height of approximately 50 ft. This will give a static pressure of

$$50 \text{ ft.} \times 0.434 \text{ lb.} = 21.7 \text{ lb. per sq. in.}$$

which added to the frictional loss gives a total pressure on the radiators and boiler of

$$21.7 + 1.8 = 23.5 \text{ lb. per sq. in.}$$

If the installation is operated as a closed system there will be a further pressure on the radiators which must be taken into consideration. If the building should be over ten stories in height it would be best to divide the heating system into two zones to avoid any undue pressure.

It is with some degree of sadness that I beg to announce that this is the last article of this series and I hope that it may have been of some aid during its eighteen months of publication. I have come into personal contact with many of my readers and by correspondence with many others. The associations have all been happy ones and I wish to thank them all for their many kind expressions of encouragement. Owing to their request I am happy to say that the articles will be compiled in text form with some additions and should be off the press during the coming summer months. If I can be of aid, I shall be pleased to answer any letters sent to me.

Laying Out a Sprinkler System

by **Lt. Col. John B. Coleman***

The author of this article has outlined the rules and laws applying to the installation of sprinkler systems, presented a sprinkler piping schedule, and given important data concerning sprinkler spacing for various types of construction.

●

IN simple form, a modern sprinkler system consists of:

Water supply
Supply pipe or main header
Distributing pipes
Sprinkler heads

The water supply is usually from any two of the following sources: Reservoir pressure from either public or private mains; elevated gravity tank or air pressure tank, or Underwriters' fire pump.

In some cases this duplicate supply is obtained by connecting with public water mains on two different streets, or with the high and low pressure service, when these are obtainable. In many cases, a single city water supply is sufficient, thus reducing the initial cost.

APPROVED DEVICES ONLY SHOULD BE INSTALLED

A sprinkler system, unlike almost any other piping system, is installed with the hope that it will never have to operate. That is, that there will never be a fire which will cause the sprinklers to open, the dry pipe valves to trip, etc. Therefore, these devices must remain inactive. However, they must be of such a character that at any time after they are installed they will be immediately ready to operate. The sprinkler itself is a sensitive valve held closed but ready to open during the whole life of any sprinkler system. Therefore, in installing any sprinkler system one of the prime requisites should be that all devices to be installed are approved by either Underwriters' Laboratories or Factory Mutual Laboratories, or both.

Sprinkler equipment is governed by definite rules promulgated by these two bodies. Among these regulations are those of the National Board of Fire Underwriters for the installation of sprinkler equipment, those of the National Board of Fire Underwriters for outside protection, those of the National Board of Fire Underwriters for the installation of class B sprinkler systems, those of the National Board of Fire Underwriters for the installation of rotary fire pumps, regulations of the National Board of Fire Underwriters for the installation and operation of centrifugal fire pumps, those of the National Board of Fire Underwriters for the construction and installation of tanks, and many others.

These are paralleled by the publications of the Associated Factory Mutual Fire Insurance Companies known as the Rules for Installing Sprinkler Equipments, specifications for gravity water tanks, rules for laying cast-iron pipe in factory yards, the specifications for valves, indicator posts, and hydrants, specifications for centrifugal fire pumps, etc. These rules are kept up to date and revised year by year and are, practically speaking, simply the modification of rules that are developed through a long experience. In one of the booklets the following statements are made:—

"To be reliable a sprinkler must be sensitive to the action of heat, not readily subject to corrosion, and sufficiently strong to withstand considerable strain over a practically indefinite period. It must have an initial tension sufficient to provide for prompt opening after the fusion of the link and yet not so much tension as to cause premature opening." To be assured of these features of reliability sprinklers submitted for approval are subjected to a series of very thorough tests covering a considerable period of time.

SPECIAL WRENCHES USED IN INSTALLING SPRINKLERS

Special wrenches are made for use in installing sprinklers and these should always be used. Similar care should be exercised in storing and transporting sprinklers to that given a piece of delicate machinery.

One of these sets of rules states: "Sprinkler installation is a trade in itself. Inspectors cannot be expected to act as working superintendents, or correct errors of beginners. Sprinkler work should be entrusted to none but fully experienced and responsible parties."

Another makes the point that for best results only experienced workmen should be employed.

Both say in substance that care must be taken so that after pipes are cut they are properly reamed to remove all burrs and fins; also that threads are cut to standard so that joints will be properly made without obstructing waterway. Also they point out that all distributing pipes should be straightened before installation in order to prevent pockets between hangers which would interfere with the proper distribution of the system.

*Chief Engineer, Grinnell Company.

RELIABLE CONTRACTOR SHOULD INSTALL THE SYSTEM

In all cases pipe should be installed in such a way that it drains back to the riser supplying the whole equipment. This is absolutely necessary in dry pipe systems and should be done in all systems so as to prevent water from being pocketed in these pipes; in the case of the dry pipe system, to prevent freezing; and in the wet pipe system, to prevent damage in case it were necessary to drain the system and to take certain pipes out for repairs or extensions of any nature. Therefore, it is always advisable to entrust this work to a reliable and responsible contractor.

In general, the following pipe schedule governs the installation of sprinkler piping.

SPRINKLER PIPING SCHEDULE*

In no case should the number of sprinklers on a given size pipe on one floor of one fire section exceed the following:

Size of Pipe, In.	Maximum Number of Sprinklers Allowed
¾	1
1	2
1¼	3
1½	5
2	10
2½	20
3	36
3½	55
4	80
5	140
6	200
8	400

*Note.—For railway car houses, see separately published Regulations for Electric Railway Car Houses and Cars.

Where practicable, it is desirable to arrange the piping so that the number of sprinklers on a branch line will not exceed eight. All heads in excess of eight should be provided with a 2½-in. pipe where, in a few cases, it may be necessary to have more than eight heads on a branch line run.

RULES FOR SPACING OF SPRINKLERS

The following rules generally govern the spacing of sprinklers:

Joisted Construction.

(a) Open Joists. Under open finish (and under sheathed or plastered finish under certain conditions) joisted construction, ceilings, floors, decks and roofs, the lines shall be run at right angles to the joists and the sprinklers "staggered spaced," so that heads will be opposite a point half way between sprinklers on adjacent lines, and the distance between sprinklers not exceeding 8 ft. at right angles to the joists or 10 ft. parallel with joists, the end heads on alternate lines being not more than 2 ft. from wall or partition.

Distance From Walls.

Distance from wall or partition to first sprinkler shall not exceed one-half the allowable distance between sprinklers in the same direction. Additional sprinklers may also be required in the narrow pockets formed by bay timbers or beams and wall.

Exception—An exception may be made to this rule if the conditions warrant, viz., special permission may be given to install but one line of sprinklers in bays 10 to 11½ ft. wide from center to center of the timbers which support the joists. In all cases where such bays are over 11½ ft. wide, two or more lines of sprinklers should be installed in each bay as required by the rules for spacing. This does not apply where beams are flush with the joists. Where permission is given, the sprinklers should be placed closer together on a line so that in no case will the area covered by a single sprinkler exceed 80 sq. ft.

(b) Sheathed or Plastered Ceiling. Under smooth finish, wood joisted ceilings, the spacing of sprinklers shall be in accordance with the first paragraph except as follows: Under ceilings, in good repair, constructed of plaster board not less than ½-in. thickness covered with metal sheathing, or of metal lath and cement or gypsum plaster, or of metal sheathing on wood sheathing, sprinklers shall be spaced as follows:

In bays 6 ft. to 12 ft. wide (measurements to be taken from center to center of timber, girder or other projection or support forming the bay), one line of sprinklers shall be placed in the center of each bay. Bays in excess of 12 ft. in width and less than 23 ft. in width shall contain two lines of sprinklers. Bays 23 ft. in width or over shall have lines therein not over 10 ft. apart.

ONE HEAD SHOULD BE INSTALLED FOR EACH 90 SQ. FT.

In all cases the location of the sprinklers on each line and the distance between lines shall be such that there will be one head for not exceeding 90 sq. ft. of floor area; in no case, however, shall the distance between heads exceed 10 ft. at right angles to the joists.

In all cases, sprinkler piping shall be supported independently of the sheathing.

In such cases as small offices where the spacing required by the first paragraph would require an excessive number of sprinklers, if staggered, the spacing may be in accordance with paragraph one.

Open joisted bays 10 ft. 1 in. to 12 ft. 6 in. in width will require two lines of sprinklers except where numerous bays of this width prevail, and where joists are on top of girders, in which case lines of two and one may be installed, staggered as indicated above, in adjoining bays, except that outside bays in each case will require the installation of two lines.

Pitched Roofs.

Under a pitched roof sloping more steeply than 1 ft. in 3 ft., sprinklers shall be located in peak of roof, and those on either side of peak spaced according to above requirements. Distance between sprinklers should be measured on a line parallel with roof. Where the roof meets the floor line, sprinklers should be placed not over 3½ ft. from where roof timbers meet floor.

Sprinklers not more than 2½ ft. distant each way from the peak of room, measured on a line with the roof, may be used in lieu of sprinklers located in peak of roof as above.

Under sawtooth roofs, end sprinklers on branch lines shall not be less than 1 ft. nor more than 2½ ft. from the peaks of these roofs.

Fire Resistive Construction.

Rules for mill construction should apply as far as practicable. The rule may be modified, however, the intent being to arrange the spacing of sprinklers to protect the contents rather than the ceilings; but in no case shall the distance of a sprinkler on a line exceed 12 ft. to a sprinkler on an adjoining line.

The type of hazard to a large degree governs the spacing of sprinklers, the water supplies, etc., as well as the construction of the building.

For instance, it would be utterly foolish to require the same sort of spacing in a building occupied for the storage of films as in a building occupied for the storage of machinery. Films, of course, require a great deal more water relatively than would a building occupied for the storage of machinery.

Partitions or Other Obstructions. A line of sprinklers should be run on each side of the partition. Cutting holes through a partition to allow sprinklers on one side thereof to distribute water to the other side is not effectual. This rule applies to both solid and slatted partitions.

Where no combustible material is stored close to the ceiling, the inspection department having jurisdiction may waive the requirement for providing extra sprinklers in narrow pockets formed by beams and partitions where the construction is entirely fire resistive, including the partitions.

Heads should not be placed closer than 12 in. to uprights, ceiling blocking, hangers or other obstructions.

Mill Construction.

Under mill ceiling (smooth solid plank and timber construction, 5 to 12 ft. bays) one line of sprinklers should be placed in center of each bay and distance between the sprinklers on each line should not exceed the following:

8 ft. in 12 ft. bays.
9 ft. in 11 ft. bays.
10 ft. in 10 ft. bays.
11 ft. in 9 ft. bays.
12 ft. in 5 to 8 ft. bays.

Measurements should be taken from center to center of timbers.

Semi-Mill Construction.

"Semi-mill" is the term applied to plank and beam construction with narrow bays. Under such ceilings, the area per sprinkler shall in no case exceed 90 sq. ft. and distance between sprinklers on a line and between lines should not exceed 10 ft.

Where lines are run in beam panels, heads may be staggered not to exceed 12 ft. apart on a line.

Ceilings of modified mill construction having bays less than 3 ft. should be treated as open joist construction and sprinkler heads spaced accordingly.

Bay timbers placed 3 ft. or more on centers will require special rulings by the inspection department having jurisdiction.

When it becomes the duty of an engineer to lay out a sprinkler system, he should first familiarize himself with the rules of the Underwriters governing the installation of sprinklers. He should then submit the question of what is required for the particular place to the insurance body which handles the insurance on the risk and they can determine what the water supplies should be. There are no definite rules governing water supplies. These must be dealt with in every case individually depending upon the hazard and what water supplies may be available at the particular point. After this is determined, a specification should be drawn up indicating the number of sprinklers to be installed, the water supplies to be provided and the underground pipe connecting the water supplies to the sprinkler system should be indicated.

HANGERS AN IMPORTANT PART OF SYSTEM

One of the important parts of a sprinkler system is the hanger. The hangers required in a sprinkler system by the insurance authorities have more strength than would ordinarily be required. For instance the size of single rod hangers are as follows:—

Size of Pipe, In.	Size of Rod, In.
¾ to 2	⅜
2½ to 3½	½
4 and 5	⅝
6	¾
8	⅞

In addition to that provision must be made for adjustability of these hangers and great care should be exercised in the selection of hangers for a sprinkler system.

A typical specification for a sprinkler system reads as follows: Work and apparatus as described herein to be furnished by the seller, except when clauses specify buyer to furnish.

A standard dry-pipe system of . . . . . sprinklers to be installed in your three-story office and warehouse building located at the southeast corner of Main and Summer Streets.

No coated, plated or other special sprinklers are included in this proposal.

A . . . . . dry-pipe valve in each main supply to two dry-pipe sprinkler systems. Two accelerators to be connected to the two dry-pipe valves.

A valve house to be furnished by the buyer for enclosing the two dry-pipe valves, including light and heat.

Air piping between dry-pipe system and the buyer's system.

Two electric alarm gongs with necessary transformers to be installed at and connected to two dry-pipe valves. One 2-point annunciator with electric gong located in watchman's office and connected to two dry-pipe valves.

Gate valves to be installed controlling two dry-pipe valves.

Draw-off piping to properly draw off system to be run to accessible place for discharge.

If necessary to discharge draw-off to sewer, buyer to provide properly trapped sewer pipe connection and leave threaded capped outlet at point designated by us.

Piping from point where underground supply enters building to connect with sprinkler system.

Concrete inserts to be furnished by seller, buyer to place as shown on seller's plan.

Sprinkler cabinet with six sprinklers and sprinkler wrench to be provided for emergency use.

Buyer to furnish 6 in. city water connection from adequate supply at curb on Main Street, including meter, if required. Work is to begin at 6 in. standard flanged outlet provided by buyer at point designated by seller.

Deliver material at buyer's freight station, buyer to do all local teaming and handling.

All openings for proper installation of the work specified in foundations, walls, partitions, ceilings, stairways, etc. Buyer to do all patching and repairing required.

Buyer to do trench work for proper installation of the underground piping, including excavating, preparing of trenches and back-filling.

This system will be installed under the rules and regulations of, and subject to inspection by the . . . . . (Insurance Exchange).

State Laws Relating to Heating and Ventilating Industrial Buildings

(Continued from February Issue)

Laws Relating to Specific Industries and Processes.

Nine states have, in addition to their general ventilation laws applying to industrial buildings, laws relating to various specific industries, or processes, such as foundries, grinding, etc. Abstracts of such laws follow.

Pearl Goods

Sanitary and Engineering Industrial Standards of New Jersey contain standards for pipe sizes for various machines used in the pearl goods industry, together with data on safety hoods, tests, proportions and gauges of materials used in the duct construction.

Pottery

New Jersey regulations provide that dust generated in the process of manufacturing china ware, lithograph transfer work and electric porcelain ware shall be removed by an exhaust system.

Pipe sizes are given for various processes and the regulations cover tests, proportions and gauges of material.

Printing

In New Jersey all lead melting pots including linotype and monotype pots, stereotype kettles and remelting kettles shall be equipped with mechanical exhaust hoods. Linotype machines shall be provided with the following exhaust equipment:

Each lead pot shall have a hood with the following dimensions: 10 in. long and 10 in. wide at the largest end. Hood when in position shall hang at a distance no greater than six inches above the rim of the melting pot. Hood shall be so constructed as to permit it to slide on the branch pipe to which it is connected. Each hood shall have a suction pipe 4 in. in diameter.

Main suction pipe to which all branch suction pipes shall be connected shall at all cross-sectional points have an area at least equal to the combined areas of branches at each cross-sectional point.

The exhaust fan shall operate at a speed sufficient to generate an air movement in each branch pipe of at least one thousand lineal feet per minute. Test to be made by placing an anemometer at the end of the branch pipe, where it connects with the hood. Entire line shall be open and unobstructed when test is made.

Stereotype kettles shall be completely hooded, proper slots and doors being provided, as per detailed blue print, to permit of dross skimming and pump action.

Each hood shall have an 8-in. exhaust pipe in which an air movement of at least 1000 lin. ft. per min. shall be generated. Test to be made by placing an anemometer in the branch pipe at the point where it connects with the hood.

Remelting kettles, where lead slugs are remelted and cast into bars, shall be equipped with an exhaust hood of a type to be decided by the type of melting pot. In all cases an air movement of 1000 lin. ft. per min. shall be generated in the branch pipe leading from the exhaust hood. Test to be the same as in the case of a stereotype kettle.

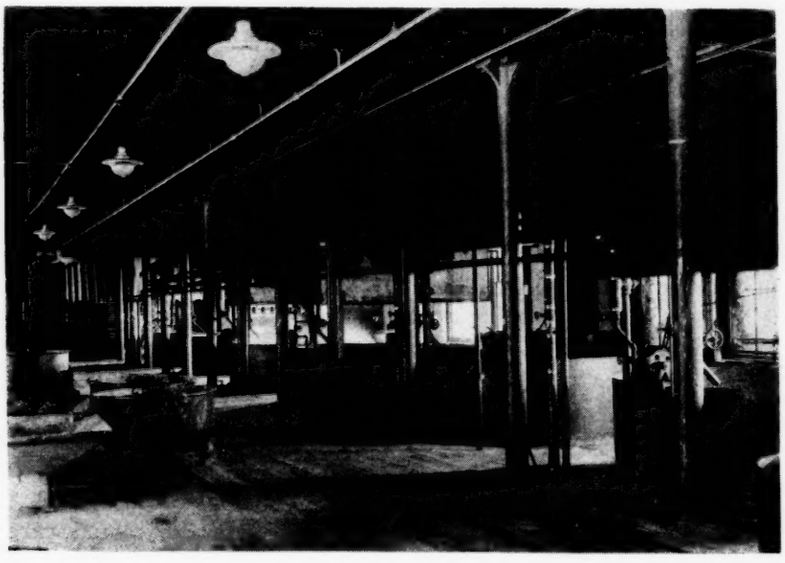
The fumes passing through the exhaust fan shall be discharged outside the workroom at a point where they cannot return through openings in the building.

Exhaust systems shall be constructed of galvanized sheet steel.

Regulations for printing and allied industries in Pennsylvania are as follows:

All gas heated lead melting pots shall be equipped with exhaust hoods and exhaust pipes sufficient to remove all gas fumes.

Plungers shall be cleaned under an exhaust hood or in a cleaning box.



An Exhaust System in a Drug Manufacturing Plant

Type metal shall be cleaned either under an exhaust hood or by means of a vacuum system.

Removal of Dust, Gases and Fumes

Industrial Code Bulletin No. 12, of New York, relating to the removal of dust, gases and fumes, states essentially that:

Every machine used for cutting, drilling, dressing and polishing stone, glass or mother-of-pearl, or for picking, carding or garnetting fibrous substances or shoddies, shall be provided with a hood connected by means of a pipe to an exhaust fan or other suction device. Every pot used for melting lead or metal compounds in any process of manufacture shall be provided with a hood connected by means of a pipe to an exhaust fan or other suction device or such hood shall be connected to a flue having efficient natural draft. Every such hood shall be so located in relation to the machine that the dust, refuse or fumes will be carried off by the pipe attached to it.

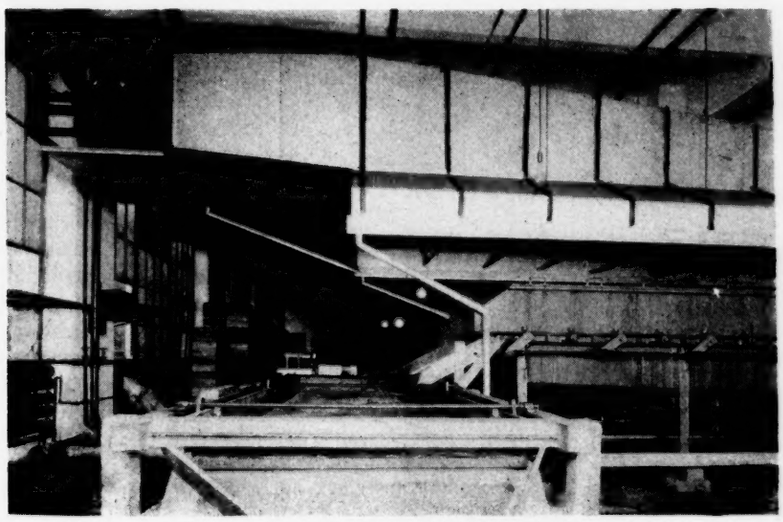
All fumes, vapors and gases emitted or created in or in connection with any process of manufacture composed of acrolein, amyl acetate, arseniuretted hydrogen, carbon tetrachloride, chromium salts, formaldehyde, hydrocyanic acid, salts of lead, nitric acid, methyl alcohol, sulphuric and sulphurous acid, ammonia, amylic alcohol, carbon bisulphide, chlorine, hydrochloric acid, hydrofluoric acid, mercury or salts of mercury, phosgene, phosphorus and its compounds, zinc and its compounds shall be removed by means of suction devices as far as practicable at their point of origin.

Every workroom in which carbon monoxide is emitted or created in or in connection with any process of manufacture shall be provided with such ventilation that the carbon monoxide shall not exceed one-half part in ten thousand volumes of air in any occupied part of such workroom.

Every work or process in the manufacture or use of white lead, red lead, litharge, sugar of lead, arsenate of lead, lead chromate, lead sulphate, lead nitrate or fluo-silicate, or in the manufacture of pottery, tiles or porcelain enameled sanitary ware, including the corroding or oxidizing of lead and the crushing, mixing, sifting, grinding, and packing of all lead salts or other compounds shall be so conducted, and such adequate devices provided and maintained by the employer as to protect the employe as far as possible, from contact with lead dust or lead fumes.

Every kettle, vessel, receptacle or furnace in which lead in any form above enumerated is being melted or treated, and any place where the contents of such kettles, receptacles or furnaces are discharged, shall be provided with a hood so constructed and located that the dust or fumes will be drawn into it, and connected with an efficient air exhaust; all vessels or containers in which dry lead in any chemical form or combination above enumerated are being conveyed from one place to another within the factory, shall be equipped, at the places where the same are filled or discharged, with hoods having connection with an efficient air exhaust; and all hoppers, chutes, conveyors, elevators, separators, vents from separators, dumps, pulverizers, chasers, dry pans, other apparatus for drying pulp lead, dry pans dump, and all barrel packers and cars or other receptacles into which corrosions are at the time being emptied, shall be connected with an efficient dust collecting system.

Such system shall be regulated by the discharge of air from a fan or other apparatus, either through a cloth dust collector having an area of not less than ½ sq. ft. of cloth to every cubic foot of air passing through it per minute, the dust collector to be placed in a separate room which no employe shall be required or allowed to enter, except for essential repairs, while the works are in operation; or such other apparatus as will efficiently remove the lead dust from the air before it is discharged into the outdoor air.



Installation of Exhausters in a Food Products Plant

Rubber Goods

Sanitary and Engineering Industrial Standards of New Jersey contain the standard regulations applying to the removal of dust generated in the manufacture of rubber goods. The branches of work covered include soft rubber goods, dusting rubber goods from which bands are cut, mixing mills, compounding rooms, light rubber goods, and hard rubber goods. Sizes of pipes for wheels, belts and mills dust grinding are given, together with standards for tests, proportions and gauges of materials.

Shoe Manufacturing

The Sanitary and Engineering Industrial Standards of New Jersey contain laws relating to removal of dust in shoe manufacturing, and list standard regulations on pipe sizes for various machines used in this industry, and data on tests, proportions and gauges of materials.

Textile

Regulations Affecting Textile Industries, published by Pennsylvania, contain Rule 274, relating to the removal of dust and flying material, which reads essentially as follows:

The following machines shall be covered and exhaust systems shall be installed for the removal of dust or fly: Dusting and opening machines in the manufacture of woolen and worsted yarns such as willows, burr pickers and mixed pickers; machines used in the preparation of cotton for carding of cotton yarns such as openers and pickers; machines used in the manufacture of cotton yarns on cotton waste cards such as willows, pickers and openers; machines used in the spinning of asbestos yarn such as willows, pickers and cards; the cylinders, workers, strippers and doffers of cards for carding cotton waste shall be enclosed. Exhaust systems, however, are not required.

Rule 275, relating to heating and ven-

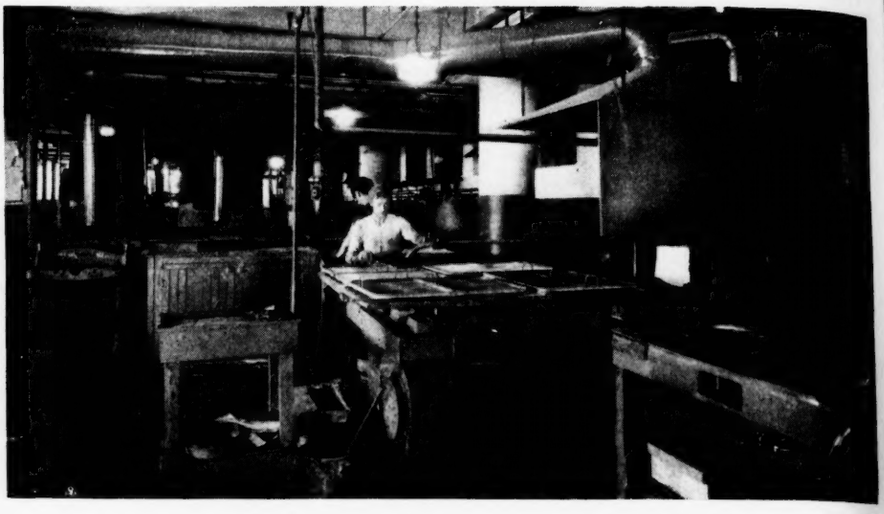
tilating, states that:

"Dye houses shall be equipped with ventilating systems which will produce the following conditions:

From November to May, inclusive, the temperature of the dye house shall be maintained between 40° and 95° F. During this period when the weather is clear and the outside temperature is 40° or more, the dye house shall be kept free from steam to a height of 6 ft. from the floor. The ventilating system employed to produce this freedom from steam shall be maintained in operation during less favorable weather conditions.

From June to October, inclusive, the dye house shall be kept free from steam at all times to a height of 6 ft. from the floor.

The systems which are used to produce these conditions may consist of ventilating fans, heating coils, hoods with flues attached over kettles, introduction of hot air or other natural ventilating devices.



Cooling Plates and Exhaust from Smelting Pot

Spray Coating

Spray Coating is covered in Pennsylvania laws substantially as follows:

Rule 3 states that all booths shall be equipped with an exhaust fan or fans capable of moving the air at all times past the working face of the booth toward the fan at a speed of not less than 125 ft. per min. as measured by a vane anemometer, except when special permission is granted for a change in velocity. This rate shall be maintained approximately uniform over not less than 75% of the working face area.

When objects are sprayed in room booths, the exhaust system shall be kept in operation constantly while spraying is being carried on, and shall effect not less than twenty changes of air per hour.

In room booths where the spray coating of objects is done by more than one spray operator working at the same time, exhaust ventilation shall be provided so that it will be unnecessary for anyone to come between the spray and the nearest opening of the exhaust system.

All exhaust ducts shall be so constructed as to be easily inspected and cleaned. All fans and ducts shall be constructed of noncombustible material. Fan blades shall be constructed of material which will not create sparks when struck by other objects. Electric motors shall be installed outside of ventilating ducts. This provision shall not apply to electric motors operating fans in wall or window openings of spray rooms, if the motors are of the two or three phase alternating current type and are shielded to prevent residue or flyings from accumulating on the motor.

When booths with a face area of not more than 4 sq. ft. are used, the rate of exhaust prescribed in Rule 3 need not be maintained except when lacquer is sprayed or when one gallon or more of material other than lacquer is sprayed at one booth, or by one operator in the course of one day's work.

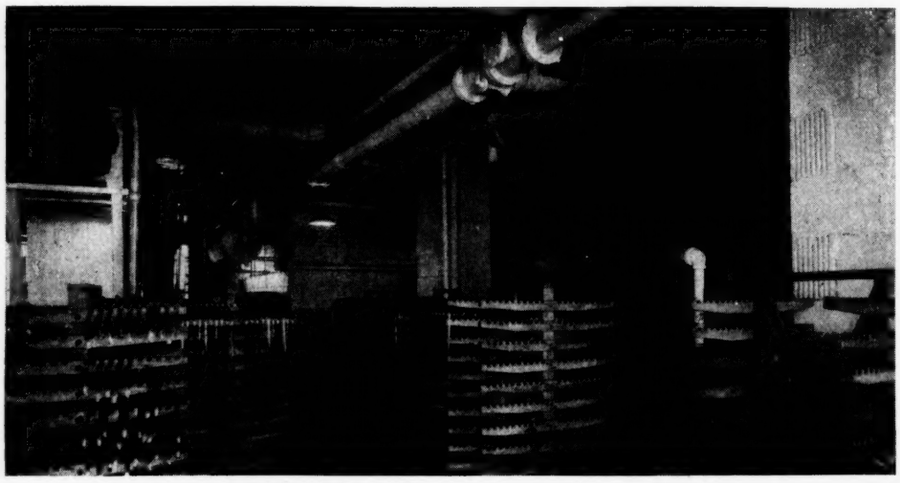
Cross currents of air shall be avoided. While spraying is being carried on, currents of air shall not be permitted from windows or from other sources that will interfere with the required velocity of the exhaust system.

All booths and room booths shall be so located and so operated as to insure an adequate amount of pure, clean air to replace the air removed by the exhaust system.

Woodworking

Sanitary and Engineering Industrial Standards of New Jersey provide that:

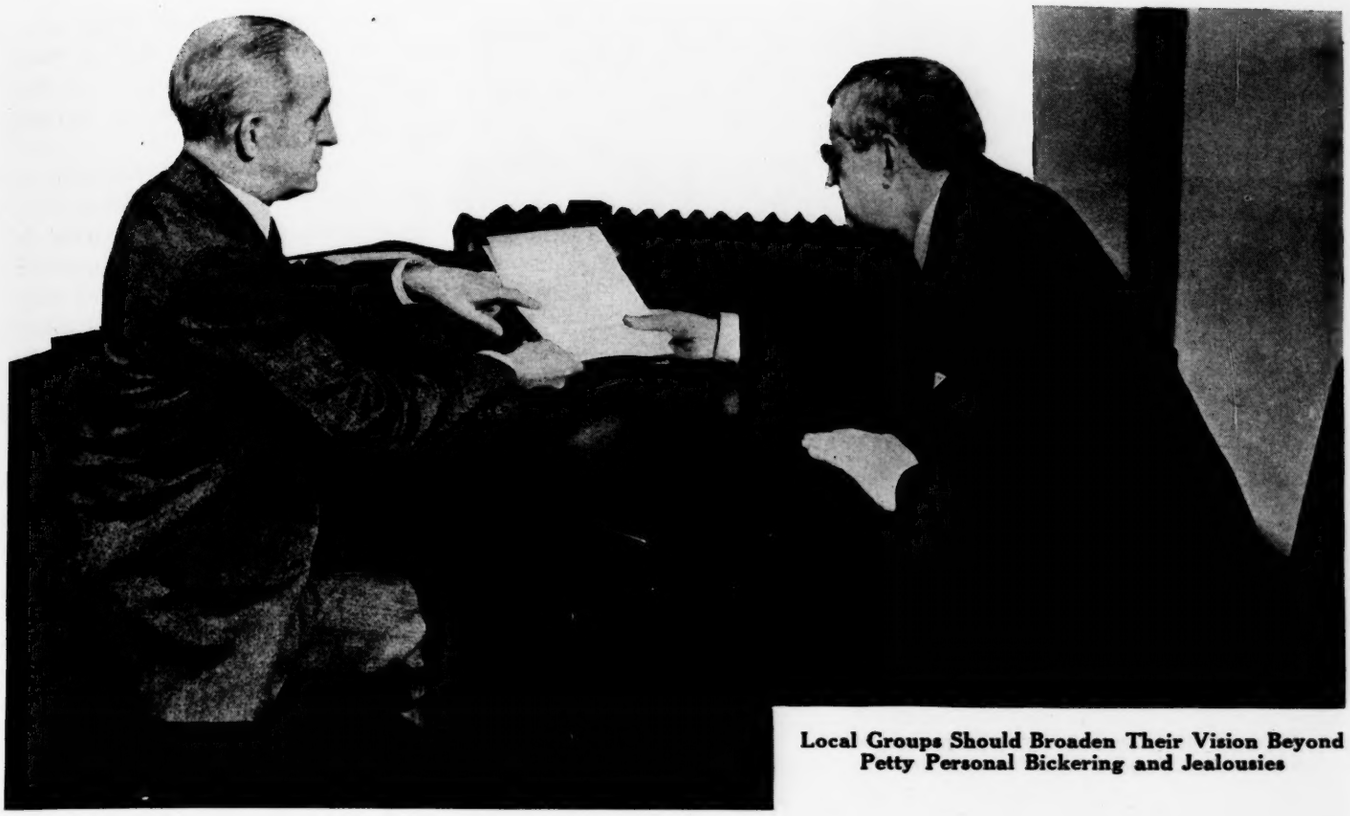
All dust and refuse material produced by woodworking machinery shall be removed by an exhaust system constructed in accordance with tables giving sizes of pipes for all types of woodworking machinery, and also standards for test, proportions and gauges of materials.



Floor Mounted Unit Heater in Auto Bodies Plant

Insurance Regulations

The National Board of Fire Underwriters publishes regulations for the installation of blower and exhaust systems as recommended by the National Fire Protection Association which apply to finishing processes, paint spraying and spray booths, pulverizing systems for sugar and cocoa, installation of pulverized fuel systems, terminal grain elevators, flour and feed mills, starch factories, dry cleaning and dry dyeing plants. Particular attention is paid to systems for removal of inflammable vapors.



Local Groups Should Broaden Their Vision Beyond Petty Personal Bickering and Jealousies

WHY TRADE ASSOCIATIONS?

by William E. Taylor

IN this article Mr. Taylor has outlined a national program of three elements of a healthy industry as follows:

Money received in payment for work is to be used for the specific purpose for which it was paid and not for capital funds.

Existing indebtedness shall be paid either in full or by amortization by agreement with creditors, and thereafter new contracts shall be paid in accordance with their terms.

Sources of supply shall reduce over-production, establish reasonable sales quotas, sound credit policies and standard terms of sale.

He has further listed two fundamental principles of local organization—willingness to have membership in the association open to all, and the elimination of the individualism which is obstructing cooperation.

IN its issue of October 12, *The New York Times* printed a sharp criticism of trade associations ending:

"In the present emergency, the trade organizations might well have taken the lead in carrying out the plans devised for a crisis. For the most part they have no such plans or little else to offer. Perhaps this slump may reduce the number of these useless bodies and bring in their place organizations able to be of real service."

Nation's Business comments that this is—

"A challenge to the manager of every trade association in the country. A challenge which each should meet."

In so far as the trade associations of the heating and ventilating industry are concerned, there will be no attempt made to meet this challenge because they have never been geared up for any such type of work. Nevertheless, the challenge stands as an indictment which I hope will awaken the members of the trade throughout the country to the need of taking their group activities out of the useless category and making their organizations of real service.

I feel that common justice demands that a distinction should be made here between the Heating and Piping Contractors National Association and the local associations.

The existence of this national organization is the one sure foundation stone upon which the industry can be rebuilt, but even a national organization can go only so far and so fast as its membership demand or permit, so that in the final analysis the problem is in the lap of the local associations. The solution, the very health of the industry itself, depends upon whether the local groups will be able to broaden their vision beyond petty personal bickering and jealousies, build up the local associations so that they really represent the trade in their locality and thus bring to the support of the national association a spirit of cooperation and support which at once demands a result and declares willingness to accept its leadership to accomplish it.

In staff ability and organization, in its officers and directors, in the committee chairmen and personnel a

The Contractor Cannot Retain his Individualism and Still be Part of Successful Cooperative Activity

perfect piece of machinery, finely adjusted and ably directed, moves smoothly and efficiently within the walls of the national headquarters and if the job could be done there, it would be done and well done. Beyond these walls the results of intelligent far-seeing and laborious work encounter the fog and chill of jealousies, selfish interests, suspicions, superstitions and ignorance to a degree well-nigh discouraging to any effort to do more than the routine.

Therefore, what I say here is directed to the individual contractor who in the final analysis bears the responsibility for conditions in his trade for he has the power to make them what he will by readjusting his personal viewpoint and conduct upon the basis of a conviction of what is right and wrong, fair and unfair, wise and unwise, and joining hands with those of like conviction to make it law, through demand and practice.

I would lay stress upon the importance of each contractor reaching a conviction as honestly as he can as to what is right, fair and wise in the conduct of his business because the flabbiness of business morale is due entirely to lack of conviction.

The opening of the business day finds the man without conviction completely relaxed morally and the day closes with a record of his having met important issues on none too high a plane.

Conviction is the breath of life to cooperation of any kind. It must be more than opinion or belief because these change too conveniently; a conviction has moral quality which sustains in the face of sacrifice which is required at times in any cooperative relationship.

It is always a question as to how much can be accomplished of voluntary nature along lines which, at times, will require some one to sacrifice a personal advantage in the interests of group morale. However small the result may be, it is certain that no better results can be accomplished through the set-up of czar-like powers because we are not cordial to any process which contains arbitrary exercise of power.

The voluntary type is the most logical for the reason that success requires that the individuals must be convinced of the value of their cooperation and each must see his special part in the process and act because of conviction.

An advocate who is convinced of the rightness of an act either from the personal or group viewpoint is more likely to stand as a supporter than the one who is a yes man through fear of power but in whom there is no conviction, only expediency, which makes him as shifting as the sands of the desert and as difficult to build upon.

PENALTIES ARE REQUIRED TO OVERCOME HUMAN WEAKNESS

Even under the best conditions we are bound to remember that we are dealing with human material with all its inherent weaknesses and must therefore provide in the form of penalty for backsliding, something of restraint and compulsion of sufficient weight in a particular situation to make, by comparison, the right way the easiest way.

Therefore, I advocate that each contractor and each group in a trade association commit themselves to a definite program of business conduct which contains the non-controversial subjects.

The preamble to such a program would be something like this: There is no mysterious element in the conduct of business. It has but one object, the making of a profit. Our business is a good business only so long as it provides that profit and therefore it is distinctly in the interest of each contractor to do those things individually and collectively which we agree will best protect and develop our business, as follows:

1. We accept as fact and adopt as principle, that monies we receive in payment for work done are trust funds to be used for the specific purpose on the specific transaction for which they are paid to us and are not to be used as capital invested in our business.

2. We accept as mandatory that existing indebtedness due and past due shall be paid either in full or by amortization by agreement with creditors and thereafter new contracts shall be paid in accordance with their terms.

3. We seek the cooperation of

our sources of supply to reduce over-production, establish reasonable sales quotas for long periods, establish sound credit practice and standard terms of sale, establish equal responsibility in sales and credit departments for loss through unpaid accounts.

These matters meet the specification of right, fair and wise and in my opinion are not controversial. It seems to me that they are more accurately described as ideals.

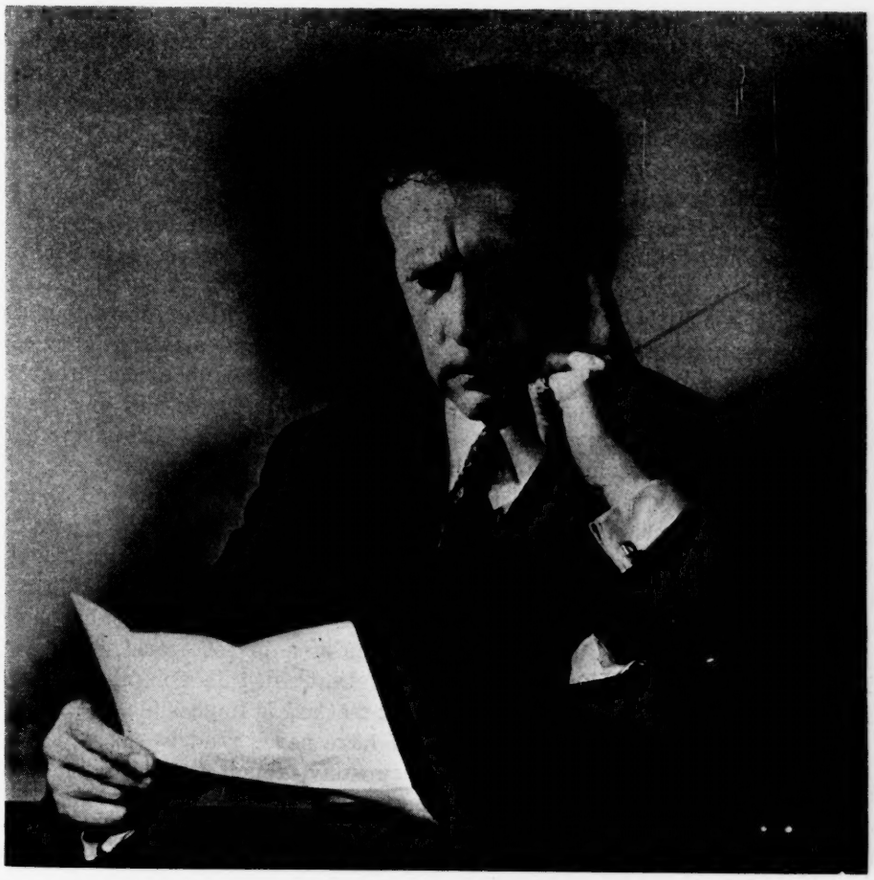
The discussion will arise over the methods of accomplishing them and the apparent fact that they say nothing about a host of bad practices which have become part of the trade.

I have intentionally omitted any attempt to specify these practices because their name is legion and we would soon be lost in a maze and be concerned with the detail of results rather than underlying causes.

MATERIAL SUPPLIER IS CARRYING THE BURDEN

Furthermore, these details arise in connection with the contractors' major activity, the getting of a contract and the existing laxity in the payment of accounts, and handling of money received as capital. Credit and terms of sale have made it possible for the contractor to pass on a large part of the burden caused by his bad judgment to the material supplier or postpone the day of reckoning indefinitely through the manipulation of money received for their services and pyramiding losses. This can be done so long as he can continue to get his hands on new money through the process of taking on more contracts carrying a constantly diminishing element of profit.

I have been told by contractors who used these methods in order to get new money that it was cheaper to take contracts at no profit, than to borrow the money at legal rates or interest. That merely illustrates the mental attitude of that type of contractor—entirely wrong and badly distorted, due to the necessity and absolute inability to secure money at regular rates of interest because any statement of his business would not justify it. The damnable part of the situation is that, due to laxity in the directions described, he has at his disposal unlimited sums of money, secured with little or no obligation, which he can use to continue on his way, destroying the industry until bankruptcy overtakes him. Then he starts all over again, perhaps, but not necessarily under a new name.



Taking Contracts at No Profit is Not Cheaper Than Borrowing Money at Legal Rates of Interest

Photos by Ewing Galloway

The late George W. Perkins is credited with saying: "Some day the law will stop trying to make business men lose money. The law will compel business men to make money."

That day seems to be a long way off, but I believe it will come. When it does, efficiency will be higher, overproduction will be less a part of the problem and additional manufacturing plants will be fewer.

To put my thought into other words, I believe that by taking care of the underlying causes, most of the bad practices will disappear and, consequently, any time devoted to them now would be ineffective.

It must be understood also that these basic things, while they do intimately concern the individual contractor's business health, in a broader sense concern more intimately the health of the industry. In other words, we are planning for the health of the contractor by prescribing for the industry—treatment from the top down, so to speak. There is, however, much to be done also from the bottom up, in addition to taking this prescription which is by no means a panacea.

This may be termed the national program, supported of course by the local groups throughout the country. In addition to this the local groups each have their individual problem, the details of which will be the same in some instances, yet having enough of difference and purely local color to require local conclusions in determining the remedy assisted, as far as may be, by a cross section of all conditions.

For example, methods which fittingly apply in large metropolitan centers would be impossible in some localities, yet a knowledge of these methods might be of value in creating a purely local adaptation.

In working out the local problems the master key to success is willingness to have membership in the trade groups open to all, even if it requires a classification of membership.

It is not possible to accomplish anything of value if the group is too highly selective and the very mini-

mum of numerical strength permissible must represent in total an overwhelming preponderance of buying power. Otherwise an attempt to set up standards of any kind becomes a millstone on the neck of the optimists with the result that even they soon become discouraged, the effort disappears, and often the trade association dies a natural death. If it remains it has little usefulness and is more of an added expense to the industry than a benefit.

Activities of this type of trade association consist principally of gestures, like passing resolutions which may be very pretty, but to which no one pays any attention because it is known that there are too many outside who do not even know about them.

MAJORITY OF CONTRACTORS ARE OUTSIDE ASSOCIATIONS

Stop and think for a moment. You may be advocating a most desirable condition which is right, fair and wise but you need the cooperation of your sources of supply, who admit the rightness of your point of view, but your group represents only 30% of the buying power of the locality. Since 70% of the buying power is outside of your membership, are you using good judgment to expect the help of your suppliers?

You never will get it and, what is more to the point, you have no right to expect it. You don't represent anything in the American way but yourselves and if you ever hope to be the voice of your industry you will first have to change your holier-than-thou attitude, and in practical ways make it possible and desirable for all who will to join your group to the end that, when you speak, your voice is heard and interpreters are not necessary.

Before I leave this subject, and I consider it the most important phase of association activity, I want to point out that it has the same value in dealing with your labor problems. Frequently in the past you have had examples in which the unorganized contractors—the 70% referred to before—have been the seeding ground for conditions which ultimately you have had to meet. Good generalship attacks the weakest front.

So, if your association doors are closed and hard to open, oil the hinges and put *Welcome* in large letters upon the doormat, realizing that if you have something good to sell its usefulness is enhanced by the number of users, and that without users it goes off the market.

Dr. John Dewey, professor of philosophy at Columbia University, in a recent letter addressed to Senator George Norris of Nebraska, said some things which interested me tremendously and although they are connected with the political situation they are so important in our social and business life and germane to this subject that I shall quote them. He says: "The Republican (and Democratic) party stands for rugged individualism . . . . Republican leaders believe that by giving free reign to private competition somehow they will build a better world. You believe that in this complicated age that method is impossible. . . . ."

I have never read words which so accurately touch the fundamental causes for business laxity and dissatisfaction and social unrest.

I said in an earlier article* "I believe that he (the contractor) has both the brains and the courage to get back upon the highway of success. What road shall he take? — that is a more serious question. If I were to answer it in the light of his actions thus far, I would change one word to make it read—what road will he take—and then it would be unanswerable because he has always thus far been a true disciple of rugged individualism and apparently been willing to pay its price.

INDIVIDUALISM HAS CAUSED FAILURE OF ASSOCIATION EFFORT

"Individualism — that means he will do as he pleases when he pleases and to whom he pleases without regard to any resulting effects outside of the immediate transaction.

"If I did not believe that he is now ready to harness his indivdualism, limit its freedom and intelligently direct it, I would not bother about it."

This is the place to discuss individualism and what should be done about it, for if the contractor thinks he can retain his individualism and yet be part of successful cooperative activity he is one of those who want rules to restrain the other fellow while he gives mere lip service. It can't be done.

More than any other single cause, perhaps, this has caused failure of association effort.

We Americans fairly worship our rugged individualism and seem to be blind to the fact that it is a false god. It undoubtedly has been a constructive force in the past and should share as one of the factors in the commercial and social development of the country. It behooves us, however, to examine it anew in the light of existing conditions, for freedom may easily degenerate into license which has no respect for anything in organized life.

TIME HAS COME FOR CALLING HALT ON INDIVIDUALISM

That, it seems to me, is what has happened to individualism and it is time to call a halt no matter how unpopular the effort may be.

Rules of conduct created a century ago need reinterpretation in the light of today and I am convinced that careful analysis will reveal that with the increase of competition having free reign, the constructive characteristics commonly attributed to individualism have become badly soiled by the things which have been done in its name.

Therefore in laying the foundation stones for your trade association add one which recognizes the usefulness of good leadership, knows the purpose and is not concerned with mere difference in method or expression, for few of us think or act alike under similar conditions and if for no better reason than that you have enlisted in the cause of improving your industry, give your wholehearted support to the chosen leader so long as he remains as such.

Naturally, I assume that full opportunity will be given each individual to express himself upon any important issue and majority rule will prevail in the decision, but once the decision is recorded and until it is changed by the same method used in its creation, man to man discussion, lip service saying "yes" and actions which mean "no" is the rankest kind of betrayal and should be dealt with swiftly regardless of the size or importance of the contractor.

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*Heating and Ventilating, February, 1931.

Abstracts . . .

Reviews and Summaries of Current Papers, Books and Pamphlets

Construction of Chimneys and Fireplaces

U. S. Department of Agriculture, Farmers' Bulletin No. 1649. 16 pages, 6 in. x 9 in., 16 figures, price 5 cents. Obtainable through Superintendent of Documents, Washington, D. C.

THIS little booklet, although non-technical and specifically directed to those persons who superintend the construction of their own homes, is filled with information of value to heating engineers as well. The material relating to chimney construction, although well presented, contains little of interest. The section devoted to fireplace design is unusually well done in that not only are some rather specific recommendations made as to dimensioning, but the description of the operation of fireplaces is made clear by well-drawn sketches. The following rule is recommended for arriving at the size of the fireplace flue—thirteen square inches of chimney flue area for each square foot of fireplace opening.

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Conversion of Coal-Fired Boilers and Furnaces to Gas-Firing

by **William D. Edwards**

Paper presented at the Fourth Fuels Meeting of A.S.M.E., Chicago, February, 1931. 4 tables, 2 charts, 2 photos, about 5500 words.

THE paper describes some of the features of the building up of a natural gas heating load in Memphis and some of the author's experiences in that work.

The heating load in Memphis in terms of degree days is shown in tabular form. This is broken down into monthly figures. Two interesting charts show the relation between oil and gas and between coal and gas with the efficiency of use as one of the coordinates. The author states: "The entire question of determining the relation between coal and gas resolves itself into the efficiencies to be secured by each. In the absence of test data, it is simply a matter of the good judgment of the engineer in his survey."

In connection with the subject of estimating requirements he states: "Locally, with 3,000 degree days a gas consumption of 400 cu. ft. per season would be based on a factor of 0.133 cu. ft. per sq. ft. (of installed radiation) per degree day.

"The consumption of 400 cu. ft. is about the low limit for steam radiation, and it may range up to nearly twice this amount, 550 to 600 cu. ft. being considered a good average, or a factor of from 0.18 to 0.20 cu. ft. per sq. ft. per degree day."

The author appears to feel that there is much evidence to justify the use of conversion burners instead of gas-designed or "gas-fired" ones as he calls them. He also describes some of the methods in use in making such conversions.

The matters of burner location and of fire travel are discussed, the author feeling that much can be done to improve existing methods and that a study of these matters would prove fruitful. He discusses the item of burner operation and points out that off-and-on methods may cause a severe tax on the burner.

Thermostatic control comes in for attention and the author speculates as to whether it might not be wise to attempt to develop hand control methods in view of the widened market which could be reached if such methods were readily available.

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Utilization of Hot Springs for Heating in Iceland

by **Ben Gröndal**

A.S.H.V.E. paper, annual meeting January, 1931. About 2500 words, 9 photos, 1 drawing.

DESCRIBES the work done by the Icelandic Engineering Association in boring for hot water, available from hot spring, with a view toward using the water for heating buildings in Reykjavik, the capitol of Iceland. It was found that six gallons of water at a temperature of 183° could be obtained per second.

The city authorities decided to pipe the water from the springs about 2 miles, and the author briefly outlines the features of the system. Three pumps force the water through 7-in. welded pipes, insulated with cork-concrete, jute and felt paper. Three buildings are being heated, the National Hospital, a school and an enclosed swimming pool. A storage is to be installed so as not to lose the water available at night. The system will then supply about 320,000,000 B.t.u. per 24 hr.

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Heating Effect of Radiators

by **R. V. Frost**

A.S.H.V.E. paper, annual meeting January, 1931. About 3200 words, 7 drawings.

SHOWS results of comparative tests on cast iron radiators and copper fin radiators from the standpoint of heating effect and steam consumption. Tests were made in two identical rooms cooled by water and air flowing over the outer walls. By this means the rooms, each with a different radiator, could thus be maintained with certain conditions the same. The tests were run simultaneously, the room temperature at the floor line and knee-height being maintained at the same point, so far as possible in each room.

Three points are brought out by the tests: (1) the ceiling temperature for the cast iron radiator was higher than that for the fin type but the reverse was true at the breathing line; (2) the fin type radiator with a cabinet heats the zone from the floor to the breathing line with a lower hourly rate of condensation; (3) the author explains (2) by stating that the cabinet reduces the amount of heat lost by radiation

through walls and glass and enables the fin radiator better to distribute its heat in the lower zone. He states that the saving due to the better utilization and distribution of heat by the fin type amounts to at least 20%.

The paper proposes that the index of heating comfort should be based on the uniformity of temperature in vertical height as well as on relative humidity.

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Air Leakage Through Various Forms of Building Construction

by **F. C. Houghten, Carl Gutberlet *and* C. A. Herbert**

A.S.H.V.E. paper, annual meeting January, 1931. About 1800 words, 5 line drawings, 4 charts, 1 table.

DATA resulting from tests conducted at the research laboratory of the society. Testing apparatus illustrated. Principal results are included in the following table but the paper includes also graphical charts.

No.	Type of Construction	Age in days	Wind Velocity Miles per Hour 5	10	15	20	25	30
			Infiltration in c.f.h. per sq. ft.					
1.	13 in. plain brick wall	22	1.80	4.90	9.35	14.50	20.30	25.50
2.	As above, with plaster on brick	183	0.006	0.016	0.031	0.054	0.084	0.121
3.	As 2, plaster removed, wall re-painted	384	1.35	3.25	6.15	10.20	14.95	20.00
4.	As 3, with one coat paint	387	1.25	2.85	5.10	8.00	11.60	15.65
5.	As 3, with three coats paint	398	1.05	2.45	4.50	7.00	9.60	12.50
6.	As 3, with six coats paint	406	0.02	0.06	0.10	0.15	0.20	0.25
7.	Frame wall, siding, sheathing, studs, lath and lime plaster	156	0.25	0.60	1.10	1.90	2.95	4.10
8.	As 7, but gypsum plaster instead of lime plaster	145	0.25	0.45	0.75	0.95	1.10	1.35
9.	As 8, with sizing and paper added	266	0.10	0.22	0.42	0.60	0.75	0.95
10.	7/8 in. sheathing, studs, paper, metal lath and stucco	...	0.12	0.25	0.40	0.50	0.70	0.90
11.	13 in. brick-and-tile wall	...	1.05	2.90	5.55	8.60	12.15	16.15
			Infiltration c.f.h. per ft. of crack					
14.	Average crack between frame and plaster or stucco	...	0.06	0.135	0.236	0.360	0.50	0.65

In building the test walls an attempt was made to follow as nearly as possible the practice of the building industry.

The table shows clearly the great decrease in the infiltration resulting from applying plaster to the brick wall. The table also shows that the careful calking and painting of brick walls will produce a reduction of infiltration comparable to that obtained by the use of plaster. However, the author states regarding this point:—"It should be emphasized, however, that this result is obtained only through a very laborious process of searching out all cracks and crevices and seeing that they were sealed up and covered with paint. It is doubtful if this is a practical procedure."

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Fundamentals of Heating

by **A. M. Daniels**

Cloth bound book of 173 pages, 6 in. x 9 in., published by the author. Price $4.00.

A BRIEF treatment of the subject intended apparently for the beginner who wishes a thorough mastery of the principles. Arranged for self-study with short explanatory paragraphs followed by problems relating thereto. Self-grading pages are presented at intervals. The book is subdivided into ten chapters, each of which constitutes a lesson. Complete solutions to all the problems are appended.

Skin Temperature in its Relation to the Sensation of Comfort

by **Emma France Ward**

The American Journal of Hygiene, July, 1930, pages 130-154. Numerous tabulations. A bibliography of twelve titles appended.

REPORT of the results obtained in a study carried on at Johns Hopkins by the author to determine "whether it might be possible to find an objective physiological criterion for the determination of comfortable conditions for human beings." The study was made using four persons as subjects, in an air conditioned room. Temperatures were varied over a considerable range, with humidities from 25% to 50%, and with but little air movement.

"The results obtained would seem to indicate that the temperature of the skin, as measured over the forehead and carotid may be used as an index of comfort of the individual."

Limits of the comfort zone under winter conditions in a temperate climate are stated as indicated by the study.

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Symposium on Small Stokers

by **T. A. Marsh**

A paper prepared by the Midwest Stoker Association and presented by Mr. Marsh at the Fourth National Fuels Meeting of the A.S.M.E., February, 1931.

AFTER summarizing the present situation regarding the use of domestic fuels and pointing out the failure of engineers to appreciate the extent of the problem, the author passes to a consideration of the physical problem involved.

The stoker types are of two general kinds: overfeed and underfeed. Stokers are available with capacities as small as 10 lb. per hr.

In the main, the stokers must be designed for particular kinds of fuel as no one stoker is capable of handling all coals. The low-grade fuels in each locality are the ones of most importance from the standpoint of stoker design. Many of these have low fusing points for the ash and some small stokers have been developed with the deliberate intent of fusing the ash and removing it from the grate.

Water-walled furnaces are common in heating practice and it is estimated that they reduce the furnace temperature 300 to 400° below that prevailing in refractory-lined furnaces. A maximum heat absorption of 40,000 B.t.u. per sq. ft. of water wall per hr. may perhaps be reached.

Automatic control has been applied to small stokers until they may be operated safely and with little attention or attendance.

The following conclusions are listed:

1. Thermal efficiency with small stokers is approximately 30% greater than with hand-fired operation.
2. Equipment must be inherently smokeless as education in this respect is futile.
3. Stokers of design to fit small heating boilers have reached a high state of development.
4. The lower priced coals are successfully burned, including fuels with ash of 20%, moisture 20% and sulphur 5%.
5. Furnaces should have a heat release of not to exceed 50,000 B.t.u. per cu. ft. per hr.
6. Liberal sized stokers are necessary.
7. Smokeless combustion is assured in furnaces of the prescribed proportions.
8. With such furnaces and with proper sizes of stokers, combustion losses can be reduced to a minimum. The excess air for combustion can be held to 30% and losses due to carbon in the refuse can be held below 2%.
9. Automatic control of stokers has been developed to a point comparable with that of oil and gas.
10. Research is required in the matter of furnace design to differentiate between water-cooled and refractory furnaces and to establish definite standards for the design of each. This must be sufficiently comprehensive to cover the various commercial boilers, stokers, and full range of fuels.
11. The commercial and merchandising problems are of such broad scope and so vastly different from that of the larger stoker that much intensive research must be done best to fit the stoker to the average installation and produce the best average results.

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Engineering Service to Anthracite Users and Recent Developments in the Utilization of Anthracite

by **C. A. Connell**

A paper presented at the National Fuels Meeting of the A.S.M.E., February, 1931.

DESCRIBES the work of the Anthracite Coal Service in its efforts to supply engineering information to users and retailers of anthracite, together with a description of the development and testing work carried on at the Anthracite Laboratory.

An interesting point brought out is that 62% of the complaints of users were found to be due to faulty equipment when engineers examined approximately 2000 domestic heating plants.

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Embrittlement in Boilers

by **Frederick G. Straub**

University of Illinois Bulletin, No. 216, *Engineering Experiment Station, dated October* 21, 1930. 128 *pages,* 46 *figures and photos,* 31 *tables. Price* 65 *cents.*

THIS bulletin reports an investigation carried on cooperatively with the Utilities Research Commission. It is an extension of a subject long under investigation at the university. The present bulletin is a partial reprint of two others previously published on the same general subject.

The author states (page 9) that "The purpose of this investigation has been to gather data relative to the occurrence of this particular type of boiler plate cracking in order to determine the cause of the difficulty and to devise methods of preventing it."

Data presented consist of those found both from examining cases of embrittlement in the field and through laboratory tests.

Data are presented very clearly and interestingly, largely in narrative form, and the whole story of the embrittlement studies is unfolded. Interesting micrographs are numerous. A summary of the cases studied and an extensive bibliography are included.

The conclusion reached is that embrittlement in boilers is caused by the combined action of stress and chemical attack. Sodium hydroxide is considered to be the chemical causing the trouble. Several conclusions regarding means of preventing the embrittlement are included. These are chemical in nature, and the author states that sodium sulphate if present in proper proportions in the boiler water will stop the embrittlement entirely.

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Capacity of Return Risers for Steam and Vapor Heating System

by **F. C. Houghten** *and* **Carl Gutberlet**

A.S.H.V.E. paper, annual meeting January, 1931. *About* 300 *words,* 3 *line drawings,* 6 *graphs,* 6 *tables.*

DESCRIPTION of testing apparatus, procedure and summary of results of the closing phase of the study of pipe sizes for steam heating systems which has been under way for several years. The data cover 1 in. and ¾ in. risers. Condensate and air were passed through an experimental riser under controlled conditions. Rates of flow and the proportion of condensate and air were varied over a considerable range. Flow took place both under gravity head and with the use of a vacuum pump.

Charts are presented showing the relations between the drop in pressure in the riser and the condensation load for various rates of air elimination.

Tables are shown which are based on the results of this study, and which may be used for sizing return risers.

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Progress in Heating and Ventilating During the Past Quarter of a Century

by **Reginald Pelham Bolton**

A.S.H.V.E. paper, annual meeting January, 1931. *About* 2000 *words, no illustrations.*

THE period from 1905 to 1930 is reviewed. The author mentions the three books in use at the beginning of the period as being those of Carpenter, Baldwin, and Moore. He describes some of the difficulties encountered in making calculations for the buildings in the Grand Central group —difficulties largely due to a lack of authoritative data. He mentions some of the appliance developments, and pays tribute to the rise of air conditioning. The increased use of the fuels other than coal is mentioned. Research work conducted at the laboratory of the society is credited with having produced marked changes in practice.

Heating and Piping Contractors National Association Standard Radiation Estimating Table

Through the courtesy of the Heating and Piping Contractors National Association, the Standard Radiation Estimating Table is reproduced below, together with instructions and data necessary for its use.

The Standard Radiation Estimating Table, is constructed on the same principle as the separate tables computed for each city and reads from lineal feet of crack or from areas to direct steam radiation required. It differs from the older table in two particulars:

First—Instead of giving U for certain type of construction the columns are headed with U taken at equal intervals from 0.08 to 1.00. This was done because it will make the table easy to use with the much larger number of constants given in the standards.

Second—Only one table is given which is for use in any locality. Combined temperature and exposure factors are then used and give the correct results for a given city.

The ease with which the table can be used will be seen from the following example:

EXAMPLE

Compute the direct steam radiation for the room shown in the drawing for the City of New York.

The construction is brick (8 in. thick)

INFILTRATION

Stationary Wood Sash	25	Rolled Section Steel Windows	100*
Double Hung Wood Sash	50	French Doors	100
Double Hung Steel Sash	100	Outside Doors, Residences	100
Casement Windows, Wood	100	Same with Storm Doors	50
Casement Windows, Steel	50	Same with Inner Vestibule Doors	50
		Outside Doors, Store, etc.	200

Metal Weather Strip Deducts 50 per cent.

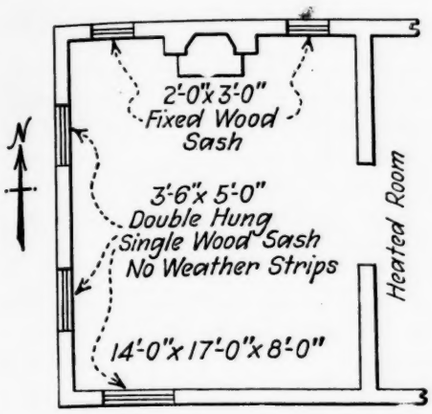
*Per foot of crack of Ventilating Sash.

HEATING AND PIPING CONTRACTORS NATIONAL ASSOCIATION STANDARD RADIATION ESTIMATING TABLE

Showing Radiation Required for Quantities Indicated

3 Col. 38″ Steam Rad.	Glass		Infiltration																				
	Window or Door	Skylight	Rate per Lineal Foot																				
			25	50	100	200																	
	1.1	1.3	0.45	0.9	1.8	3.6	0.08	0.10	0.12	0.14	0.16	0.18	0.20	0.22	0.24	0.26	0.28	0.30	0.35	0.40	0.45	0.50	0.55
225	77.0	91.0	31.5	63.0	126	252	5.60	7.00	8.40	9.80	11.2	12.6	14.0	15.4	16.8	18.2	19.6	21.0	24.5	28.0	31.5	35.0	38.5
1	2.92	2.47	7.14	3.57	1.79	0.89	40.2	32.1	26.8	23.0	20.1	17.9	16.1	14.6	13.4	12.4	11.5	10.7	9.18	8.04	7.14	6.43	5.84
2	5.84	4.94	14.3	7.14	3.58	1.78	80.4	64.2	53.6	46.0	40.2	35.8	32.2	29.2	26.8	24.8	23.0	21.4	18.4	16.1	14.3	12.9	11.7
3	8.76	7.41	21.4	10.7	5.37	2.67	121	96.3	80.4	69.0	60.3	53.7	48.3	43.8	40.2	37.2	34.5	32.1	27.5	24.1	21.4	19.3	17.5
4	11.7	9.88	28.6	14.2	7.16	3.56	161	128	107	92.0	80.4	71.6	64.4	58.4	53.6	49.6	46.0	42.8	36.7	32.2	28.6	25.7	23.3
5	14.6	12.4	35.7	17.9	8.95	4.45	201	160	134	115	101	89.5	80.5	73.0	67.0	62.0	57.5	53.5	45.9	40.2	35.7	32.1	29.2
6	17.5	14.8	42.8	21.4	10.7	5.34	241	193	161	138	121	107	96.6	87.6	80.4	74.4	69.0	64.2	55.1	48.2	42.8	38.6	35.0
7	20.4	17.3	49.9	25.0	12.5	6.23	281	225	188	161	141	125	113	102	93.8	86.8	80.5	74.9	64.3	56.3	50.0	45.0	40.9
8	23.4	19.8	57.1	28.6	14.3	7.12	322	257	214	184	161	143	129	117	107	99.2	92.0	85.6	73.4	64.3	57.1	51.4	46.7
9	26.3	22.2	64.3	32.1	16.1	8.01	362	289	241	207	181	161	145	131	121	112	103	96.3	82.6	72.4	64.3	57.9	52.6
10	29.2	24.7	71.4	35.7	17.9	8.90	402	321	268	230	201	179	161	146	134	124	115	107	91.8	80.4	71.4	64.3	58.4
11	32.1	27.2	78.5	39.3	19.7	9.79	442	353	295	253	221	197	177	161	147	136	126	118	101	88.4	78.5	70.7	64.2
12	35.0	29.6	85.7	42.8	21.5	10.7	482	385	322	276	241	215	193	175	161	149	138	128	110	96.5	85.7	77.2	70.1
13	38.0	32.1	92.8	46.4	23.2	11.6	523	417	348	299	261	233	209	190	174	161	149	139	119	105	92.8	83.6	75.9
14	40.9	34.6	100	50.0	25.1	12.5	563	449	375	322	281	251	225	204	188	174	161	150	129	113	100	90.0	81.8
15	43.8	37.1	107	53.6	26.9	13.4	603	481	402	345	301	268	241	219	201	186	172	160	138	121	107	96.4	87.6
16	46.7	39.5	114	57.1	28.6	14.2	643	514	429	368	322	286	258	234	214	198	184	171	147	129	114	103	93.4
17	49.6	42.0	121	60.7	30.4	15.1	683	546	456	391	342	304	274	248	228	211	195	182	156	137	121	109	99.3
18	52.6	44.5	129	64.3	32.2	16.0	724	578	482	414	362	322	290	263	241	223	207	193	165	145	129	116	105
19	55.5	46.9	136	67.9	34.0	16.9	764	610	509	437	382	340	306	277	255	236	218	203	174	153	136	122	111
20	58.4	49.4	143	71.4	35.8	17.8	804	642	536	460	402	358	322	292	268	248	230	214	184	161	143	129	117
21	61.3	51.9	150	75.0	37.6	18.7	844	674	563	483	422	376	338	307	281	260	241	225	193	169	150	135	123
22	64.2	54.3	157	78.5	39.4	19.6	884	706	590	506	442	394	354	321	295	273	253	235	202	177	157	141	128
23	67.2	56.8	164	82.1	41.2	20.5	925	738	616	529	462	412	370	336	308	285	264	246	211	185	164	148	134
24	70.8	59.3	171	85.7	43.0	21.4	965	770	643	552	482	430	386	350	322	298	276	257	220	193	171	154	140
25	73.0	61.8	179	89.3	44.8	22.3	1005	802	670	575	502	447	402	365	335	310	287	267	229	201	178	161	146

This Table, Together with that on the Opposite Page, Constitutes the Standard Radiation Estimating Table which can be used for all the Principal Cities



Room for Which Solution of Required Radiation is Given

furred, lathed and plastered. From standard heat loss coefficient tables, U for this construction is given as 0.250.

In the estimating table we find the two nearest columns 0.24 and 0.26. We can either use the column 0.26 or if greater accuracy is desired interpolate

INFILTRATION DATA APPLYING TO VARIOUS TYPES OF WINDOWS AND DOORS, IN CUBIC FEET PER HOUR PER LINEAL FOOT OF CRACK

Type of Opening	Cubic Feet per Hour per Lin. Ft. Crack	Specific Heat Air	Factor
Double Hung Wood Sash	50	0.018	0.9
Same with Metal Weather Strip	25	0.018	0.45
Stationary Wood Sash	25	0.018	0.45
Double Hung Steel Sash	100	0.018	1.8
Same with Metal Weather Strip	50	0.018	0.9
Rolled Section Steel Window	100*	0.018	1.8
Residential Casement Windows, Wood	100	0.018	1.8
Same with Metal Weather Strip	50	0.018	0.9
Residential Casements, Steel	50	0.018	0.9
French Doors	100	0.018	1.8
Same with Metal Weather Strip	50	0.018	0.9
Outside Doors, Residences	100	0.018	1.8
Same with Metal Weather Strip	50	0.018	0.9
Same with Storm Doors	50	0.018	0.9
Same with Inner Vestibule Doors	50	0.018	0.9
Outside Doors, Stores, etc.	200	0.018	3.6

*Per foot of crack of ventilating sash.

Storm windows, not a permanent part of the building, reduce infiltration approximately 50 per cent.

Fireplaces without dampers increase infiltration.

The factor in the last column is the number of B.t.u.s. per lineal foot of crack per hour per degree difference in temperature. This should be multiplied by the total lineal feet of crack to obtain the I used in the formula on page 11.

With three or more exposures and exceptionally good construction, an arbitrary reduction not to exceed 25 per cent of the total can be made in the infiltration loss.

0.60	0.65	0.70	0.75	0.80	0.85	0.90	1.00	0.10	0.15	0.20	0.25	0.30	0.35	0.40	0.50	0.60	0.70	0.80	0.90	U
42.0	45.5	49.0	52.5	56.0	59.5	63.0	70.0	3.50	5.25	7.00	8.75	10.5	12.3	14.0	17.5	21.0	24.5	28.0	31.5	$U\,(T_i\text{-}T_o)$
5.36	4.95	4.59	4.29	4.02	3.78	3.57	3.21	64.3	42.9	32.1	25.7	21.4	18.3	16.1	12.9	10.7	9.18	8.04	7.14	1
10.7	9.90	9.18	8.58	8.04	7.56	7.14	6.42	129	85.8	64.2	51.4	42.8	36.6	32.2	25.8	21.4	18.4	16.1	14.3	2
16.1	14.8	13.8	12.9	12.1	11.3	10.7	9.63	193	129	96.3	77.1	64.2	54.9	48.3	38.7	32.1	27.5	24.1	21.4	3
21.4	19.8	18.4	17.2	16.1	15.1	14.3	12.8	257	172	128	103	85.6	73.2	64.4	51.6	42.8	36.7	32.2	28.6	4
26.8	24.7	22.9	21.4	20.1	18.9	17.8	16.0	321	214	160	128	107	91.5	80.5	64.5	53.5	45.9	40.2	35.7	5
32.2	29.7	27.5	25.7	24.1	22.7	21.4	19.3	386	257	193	154	128	110	96.6	77.4	64.2	55.1	48.2	42.8	6
37.5	34.6	32.1	30.0	28.1	26.5	25.0	22.5	450	300	225	180	150	128	113	90.3	74.9	64.3	56.3	50.0	7
42.9	39.6	36.7	34.3	32.2	30.2	28.6	25.7	514	343	257	205	171	146	129	103	85.6	73.4	64.3	57.1	8
48.2	44.5	41.3	38.6	36.2	34.0	32.1	28.9	579	386	289	231	193	165	145	116	96.3	82.6	72.4	64.3	9
53.6	49.5	45.9	42.9	40.2	37.8	35.7	32.1	643	429	321	257	214	183	161	129	107	91.8	80.4	71.4	10
59.0	54.4	50.5	47.2	44.2	41.6	39.3	35.3	707	472	353	282	235	201	177	142	118	101	88.4	78.5	11
64.3	59.4	55.1	51.5	48.2	45.4	42.8	38.5	772	515	385	308	257	220	193	155	128	110	96.5	85.7	12
69.7	64.3	59.7	55.8	52.3	49.1	46.4	41.7	836	558	417	334	278	238	209	168	139	119	105	92.8	13
75.0	69.3	64.3	60.1	56.3	52.9	50.0	44.9	900	601	449	359	300	256	225	181	150	129	113	100	14
80.4	74.2	68.8	64.3	60.3	56.7	53.6	48.1	964	643	481	385	321	274	241	193	160	138	121	107	15
85.8	79.2	73.4	68.6	64.3	60.5	57.1	51.4	1029	686	514	411	342	293	258	206	171	147	129	114	16
91.1	84.1	78.0	72.9	68.3	64.3	60.7	54.6	1093	729	546	436	364	311	274	219	182	156	137	121	17
96.5	89.1	82.6	77.2	72.4	68.0	64.3	57.8	1157	772	578	462	385	329	290	232	193	165	145	129	18
102	94.0	87.2	81.5	76.4	71.8	67.8	61.0	1222	815	610	488	407	348	306	245	203	174	153	136	19
107	99.0	91.8	85.8	80.4	75.6	71.4	64.2	1286	858	642	514	428	366	322	258	214	184	161	143	20
113	104	96.4	90.1	84.4	79.4	75.0	67.4	1350	901	674	539	449	384	338	271	225	193	169	150	21
118	109	101	94.4	88.4	83.2	78.5	70.6	1415	944	706	565	471	403	354	283	235	202	177	157	22
123	114	106	98.7	92.5	86.9	82.1	73.8	1479	987	738	591	492	421	370	296	246	211	185	164	23
129	119	110	103	96.5	90.7	85.7	77.0	1543	1030	770	616	514	439	386	309	257	220	193	171	24
134	124	115	107	100	94.5	89.2	80.2	1607	1072	802	642	535	457	402	322	267	229	201	178	25

← These Items Figured on Basis of $U\left(\frac{T_i - T_o}{2}\right)$ →

for $U = 0.25$.

We will solve the problem using the column headed 0.26.

Taking the south wall:

The area (14 ft. × 8 ft.) is 112 sq. ft. The area of the window is 17.5 sq. ft. The net area of the wall then is 94.5 sq. ft. Looking down the column 0.26 we find the nearest area 99.2 sq. ft. and the required radiation to be 8 sq. ft.

There is a double-hung wood sash window whose area is 17.5 sq. ft. and which has 20.5 lin. ft. of crack (the sum of the lengths of two vertical and three horizontal cracks). In the column "Glass-Win. or Door" we find 17.5 sq. ft. of glass requires 6 sq. ft. of radiation.

Now the infiltration rate for double-hung wood sash is 50 cu. ft. and in the 50 column we find 6 sq. ft. of radiation will care for the infiltration.

For the south wall (disregarding temperature and exposure for the time) we have 8 sq. ft. plus 6 sq. ft. plus 6 sq. ft. or 20 sq. ft. of 3 columns 38 in. radiation.

The temperature and exposure factor for a wall facing south in New York City is shown by the table of factors to be 0.86 so this wall will need 0.86 times 20 sq. ft. or 17.2 sq. ft. of radiation.

The west wall is figured similarly but to show how easily it is accomplished the explanation will be omitted and just the results set down.

	Area or Lin. Ft.	Sq. Ft. Radiation
West Wall 17 ft. × 8 ft. = 136 sq. ft. — 35 sq. ft. (glass)	101 sq. ft.	8 sq. ft.
Two Windows 3 ft. 6 in. × 5 ft. =	35 sq. ft.	12 sq. ft.
Infiltration	41 lin. ft.	12 sq. ft.
Total for west wall (without exposure factor)		32 sq. ft.
Multiply by Temperature and Exposure Factor for west wall (page 29)		1.29 sq. ft.
Total for west wall		41.28 sq ft.
Again, for the North Wall.		
North Wall 14 ft. × 8 ft. = 112 sq. ft. — 12 sq. ft. (glass)	100 sq. ft.	8 sq. ft.
Two Windows 2 ft. × 3 ft. =	12 sq. ft.	4 sq. ft.
Infiltration (fixed sash — 25 ft. col.)	20 sq. ft.	3 sq. ft.
Total for north wall (without exposure factor)		15 sq. ft.
Temperature and Exposure factor for North Wall		1.29
Total for north wall		19.35 sq. ft.
The total for the room is		
South Wall		17.2 sq. ft.
West Wall		41.28 sq. ft.
North Wall		19.35 sq. ft.
		77.83 sq. ft.

COMBINED TEMPERATURE AND EXPOSURE FACTORS

City	Base Temp.	Temp. Factor	Points of Compass							
			N	NE	E	SE	S	SW	W	NW
Albany, N. Y.	+ 5°	0.93	1.02	1.02	0.97	0.93	0.93	0.93	1.02	1.02
Baltimore, Md.	+30°	0.57	0.80	0.80	0.74	0.57	0.74	0.74	0.80	0.80
Birmingham, Ala.	+30°	0.57	0.66	0.66	0.57	0.57	0.57	0.60	0.66	0.66
Boston, Mass.	+15°	0.79	1.02	0.86	0.79	0.79	0.79	1.02	1.02	1.02
Buffalo, N.Y.	0°	1.00	1.00	1.00	1.00	1.00	1.25	1.40	1.40	1.40
Chicago, Ill.	+10°	0.86	1.07	0.86	0.86	0.86	0.99	1.16	1.16	1.16
Cincinnati, Ohio	+15°	0.79	0.86	0.79	0.79	0.79	1.06	1.06	1.06	0.94
Cleveland, Ohio	+ 5°	0.93	1.07	1.00	1.00	0.93	1.00	1.07	1.07	1.07
Denver, Colo.*	+20°	0.80	1.04	1.04	0.96	1.00	1.00	1.00	0.80	1.04
Detroit, Mich.	0°	1.00	1.10	1.00	1.00	1.00	1.10	1.10	1.10	1.10
Eastport, Me.	+10°	0.86	1.24	1.03	1.03	0.86	0.86	1.24	1.24	1.24
Green Bay, Wis.	− 5°	1.07	1.07	1.07	1.07	1.07	1.12	1.18	1.18	1.18
Houston, Texas	+40°	0.43	0.81	0.56	0.51	0.43	0.43	0.43	0.81	0.81
Kansas City, Mo.	+15°	0.79	1.14	1.06	0.79	0.79	0.86	0.86	1.14	1.14
Los Angeles, Calif.	+50°	0.29	0.43	0.43	0.43	0.29	0.29	0.29	0.43	0.43
Louisville, Ky.	+20°	0.71	0.93	0.93	0.71	0.75	0.75	1.04	1.04	1.04
Madison, Wis.	+ 5°	0.93	1.16	1.07	1.02	0.93	1.02	1.16	1.16	1.16
Memphis, Tenn.	+30°	0.57	0.80	0.68	0.63	0.57	0.74	0.74	0.80	0.80
Milwaukee, Wis.	+10°	0.86	1.07	0.86	0.86	0.86	0.99	1.16	1.16	1.16
New Orleans, La.	+45°	0.36	0.54	0.50	0.45	0.36	0.36	0.36	0.54	0.54
New York, N. Y.	+10°	0.86	1.29	1.07	0.86	0.86	0.86	1.14	1.29	1.29
Norfolk, Va.	+30°	0.57	0.86	0.74	0.68	0.57	0.57	0.68	0.86	0.86
Philadelphia, Pa.	+15°	0.79	0.94	0.86	0.86	0.79	0.79	0.79	0.94	0.94
Pittsburgh, Pa.	+15°	0.79	1.02	0.79	0.79	0.79	1.02	1.06	1.06	1.06
Portland, Ore.	+25°	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64
Providence, R. I.	+15°	0.79	1.18	0.98	0.79	0.79	0.86	0.98	1.18	1.18
Richmond, Va.	+30°	0.57	0.77	0.71	0.71	0.57	0.74	0.74	0.77	0.77
Rochester, N. Y.	+10°	0.86	0.90	0.86	0.86	0.86	1.07	1.11	1.11	1.11
St. Louis, Mo.	+20°	0.71	0.93	0.86	0.71	0.86	0.86	0.86	0.93	0.93
St. Paul, Minn.	− 5°	1.07	1.28	1.07	1.07	1.07	1.07	1.18	1.28	1.28
Salt Lake City, Utah	+25°	0.64	0.71	0.64	0.71	0.71	0.71	0.64	0.71	0.71
San Antonio, Texas	+45°	0.36	0.61	0.61	0.50	0.36	0.36	0.36	0.61	0.61
San Francisco, Calif.	+45°	0.36	0.43	0.43	0.43	0.36	0.36	0.36	0.36	0.41
Seattle, Wash.	+25°	0.64	0.64	0.64	0.64	0.80	0.80	0.80	0.64	0.64
Syracuse, N. Y.	0°	1.00	1.10	1.00	1.00	1.00	1.05	1.10	1.10	1.10
Washington, D. C.	+20°	0.71	0.86	0.71	0.71	0.71	0.71	0.71	0.86	0.86
Wichita, Kans.	+10°	0.86	1.03	1.03	0.94	0.86	0.86	0.86	0.86	1.03

*Denver base temperature and exposure factors based on actual Weather Bureau records, but due to rapid changes and high altitude both temperature factors and combined temperature and exposure factors have been corrected to care for these conditions.

Teaching Heating and Ventilating by Mail

The successful modern heating and ventilating system in store, office, theatre or home cannot be considered as other than the product of trained minds. The human equation is the prime factor that makes it possible. From the once crude type to the present-day development on the best scientific principles, heating and ventilating systems are peculiarly the result of technical training in this field.

An intelligent understanding of these principles is an absolute requisite. No field illustrates better the value of a technical education for successful performance. In heating and ventilating, as in other lines of engineering, the demand for scientific design and skilled construction grows constantly more exacting.

The University of Wisconsin, when the University Extension Division at Madison instituted its correspondence study course in heating and ventilating, made it possible for any worker to keep abreast of progressive practice in this field while maintaining his regular business.

The special correspondence study course which is meeting the needs of students in this field deals with all the important technical points of the subject. It covers substantially the same topics and materials of instruction as are given in regular extension classes to groups of heating and ventilating men in Milwaukee and Madison. The correspondence study course, which is available to students in any state, gives the opportunity to any qualified man while still employed to take advantage of this high type of technical training.

This course consists of 24 assignments, and is conducted by Charles L. Dean, assistant professor of mechanical engineering in the Extension Division. Professor Dean is a graduate mechanical engineer of the University of Wisconsin and has had wide experience as a designer, supervisor, and installer of practically all kinds of heating and ventilating equipment in all types of buildings. In addition he has had many years' experience as a consulting engineer and as a teacher at the University of Nebraska and in the University of Wisconsin Extension Division. — *Professor Ben G. Elliott, Extension Division and College of Engineering, University of Wisconsin.*

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Heating Applications Play Prominent Part at Fuels and Power Meeting

The Fourth Annual Fuels Meeting of the A.S.M.E., held at Chicago, February 10-13, attracted a large attendance. All the sessions were filled with especially interesting papers this year and the program was very well rounded.

At the Wednesday evening session, which was devoted to domestic and building applications of fuels, papers were presented by T. A. Marsh, C. A. Connell and W. D. Edwards.

Mr. Marsh's paper, "Symposium on Small Stokers," was very well received and brought forth a very considerable amount of discussion from the floor. It is probably the first time that a comprehensive paper on the subject has been prepared for publication. Mr. Marsh's long connection with the field of coal-burning made his paper extremely interesting. It served to call the attention of the meeting quite sharply to the rapid strides being made in the development of stokers for use under comparatively small boilers.

Mr. Connell spoke on the work of the Anthracite Coal Service in its endeavor to furnish technical information for anthracite users. To many who were not familiar with the efforts being made along this line, Mr. Connell's paper* proved to be a revelation.

Mr. Edwards' paper "Conversion of Coal-Fired Boilers and Furnaces to Gas Firing"* dealt largely with the experience of a utility company in encouraging the use of natural gas in building heating plants. He outlined some of the difficulties encountered and felt that, in view of his experience in adapting coal-fired boilers to gas firing, this field of use offers considerable promise.

At the same time in the same building, the Fifth Midwest Power Engineering Conference met February 10-12.

The Tuesday evening session was devoted to refrigeration and ventilation. A paper prepared by W. H. Carrier on "New Application of Refrigeration in Air Conditioning" was read in his absence, and brought forth considerable discussion. The paper dealt largely with the application to theater buildings. S. C. Bloom in his discussion brought out the point that the present practice in theater cooling showed that cooling is now accomplished by the use of comparatively small amounts of outside air.

George Horne, in his paper "The Future of Central Station Refrigeration," not only outlined the present practice but called attention to the fact that, in his opinion, there is an excellent possibility for a wider application of central station methods to refrigeration.

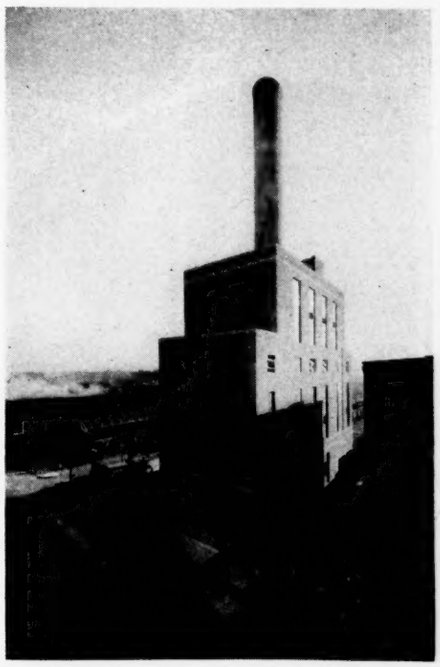
Both the Power Conference and the Fuels Meeting enjoyed a banquet and ball together on Thursday evening, February 12, at which A. O. Caldwell delivered the principal address.

The Fifth Midwest Power Exposition at the Chicago Coliseum was held concurrently with the two meetings. It attracted large crowds and at least equalled or possibly exceeded the success which has attended these expositions for the past several years.

Abstracts of these papers appear elsewhere in this issue.

Boston Edison Extends Heating Plant

Due to the rapid extension of its steam heating department, the Edison Electric Illuminating Company of Boston finds it necessary to provide more boiler capacity. An additional boiler is projected in the company's steam heating station S-2 at Kneeland and Utica Streets. It is announced that this unit will be designed to deliver 300,000 lb. of steam per hr. at the street. Installation of the boiler also necessitates a considerable enlargement of the building, at the completion of which the ultimate building plan will be approximately two thirds complete and will contain a total boiler capacity of approximately 750,000 lb. of steam per hr. It is anticipated that, with the rapid growth in popularity of the heating service, it will soon be necessary to complete the entire heating plant.



Existing Boiler Plant S-2, Boston. The Addition will be Built at the Left

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Leather Belting Specifications to be Standardized

Beginning of work on the development of national standard specifications for leather belting has been approved by the American Standards Association. According to the association $30,000,000 worth of leather belting for driving machinery is required annually by American industries. Adoption of national standards would result in savings of several million dollars per year, according to estimates based on the experience of industries in which belting specifications are used.

Work on the project will be undertaken immediately by a technical committee made up of representatives of manufacturers, distributors, large industrial users of leather belting, and government departments.

New Project for Gas Burning Appliances

The American Gas Association has been appointed sole sponsor for a new project, Approval and Installation Requirements for Domestic Gas Burning Appliances, by the American Standards Association Standards Council. The scope of the project has been approved as follows:

"Establishment of minimum or basic requirements for safe operation, satisfactory performance, and substantial and durable construction for domestic gas burning appliances; together with laboratory methods of test for determining compliance therewith."

The sectional committee in charge of the project is under the chairmanship of R. B. Harper, The Peoples Gas Light

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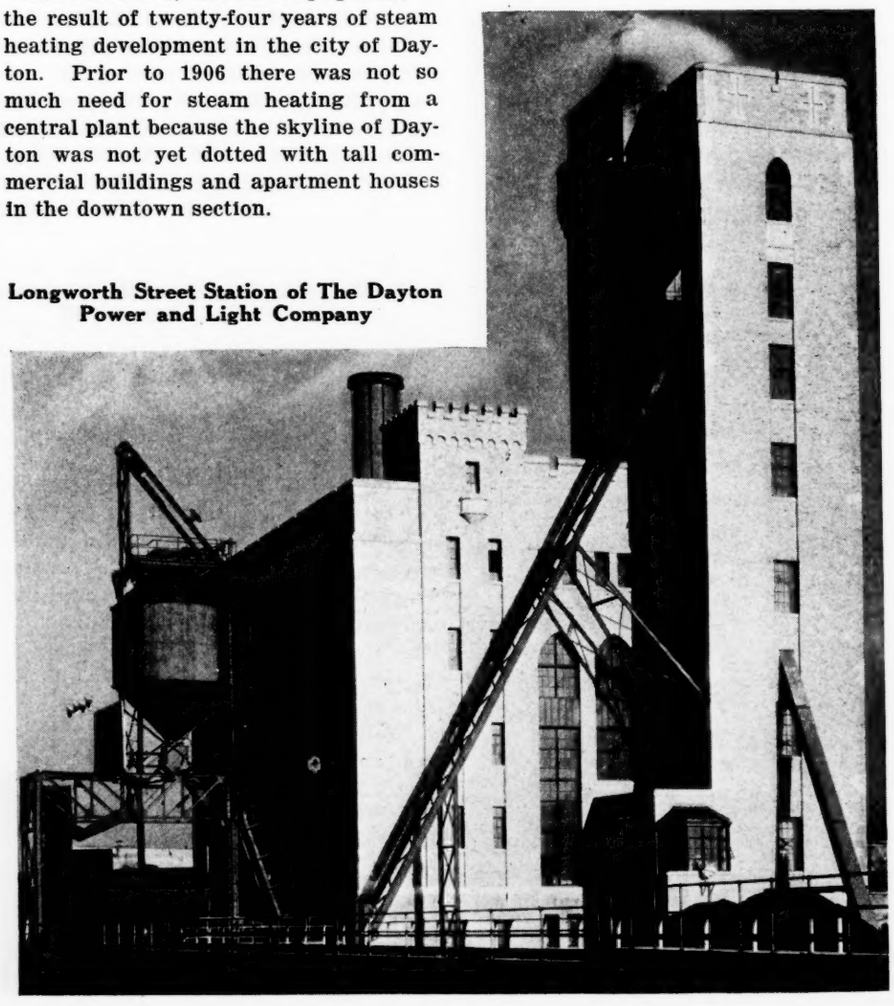
and Coke Co., Chicago, and includes in its membership representatives of five gas companies, seven gas appliance manufacturers, the United States Bureau of Standards, the United States Bureau of Mines, the United States Public Health Service, the United States Department of Agriculture, the Bureau of Home Economics, The American Home Economics Association, the Master Plumbers' Association, and the Heating and Piping Contractors National Association. The secretary of the committee is R. M. Conner, director of the A.G.A. Testing Laboratory, Cleveland.

Dayton Has Sixth Largest District Heating System

With the addition of the Longworth Street Steam Station just completed, the steam heating system of The Dayton Power and Light Company now stands sixth largest in the world, although Dayton ranks forty-sixth in population.

The structure, with its equipment, is the result of twenty-four years of steam heating development in the city of Dayton. Prior to 1906 there was not so much need for steam heating from a central plant because the skyline of Dayton was not yet dotted with tall commercial buildings and apartment houses in the downtown section.



Longworth Street Station of The Dayton Power and Light Company

The present system, with the new plant, now includes three stations, thirteen boilers and almost six hundred customers, most of whom are the large commercial and office buildings, retail stores, apartment houses and factories. The Frigidaire plant on Taylor Street is the largest consumer of steam heat service.

Anticipating the future requirements of Dayton, the new station was erected on a tract of land which will accommodate a building large enough to house six boiler units of the same size and capacity as the present boiler, and will provide space for storing 8,000 tons of coal for emergency use during the winter season.

Consulting Engineers Discuss Controls and Zoning

At the regular monthly meeting of The New York Association of Civil Engineers, held February 2, the association formally endorsed the work of the fact-finding committee, recently organized by the New York Building Congress.

Lengthy discussion took place among the members on zoning and temperature control systems for steam heating, the effect of Pendleton controls for buildings containing both cast iron and copper radiation, and the desirable room temperatures for comfort with systems of heating having widely different proportions of radiant and convected heat.

A number of different systems of orifice control and automatic radiator control valves were discussed with reference to details of their application to particular buildings. In connection with the zoning of piping systems, both vertically and as to direction of exposure, the interesting point was made, based on the experience of a number of the members, that in very tall buildings the question of indraft in the lower floors becomes a serious one.

In addition to allowing for this indraft in the sizing of radiators, it may be necessary to compensate for leaky or open windows by such expedients as weatherstripping the doors between apartments and public halls, and installing revolving doors between office wings and elevator corridors.

In the opinion of a number of members, Pendleton controls cannot be satisfactorily used where portions of the building are heated with cast iron and other portions with lightweight radiation. The reason for this is that the cast iron radiators retain their heat longer than the non-ferrous type. In this connection it was brought out that the same criticism should apply to thermostatic control of oil burners or gas-fired boilers in residences, unless houses so heated could have all important rooms served by one type of radiation or the other, rather than by both. The burner should be controlled by the steam pressure and not by the temperature of the individual room.

A number of the members reported that their experience indicates that it is possible that 68° or 70° will not be a comfortable temperature for the average American occupant in rooms heated entirely by convection. This standard of comfort was originally established with exposed cast iron radiation giving out about one-third radiant and two-thirds convected heat.

Recent experience with rooms heated almost entirely by radiant heat has seemingly established that comfort is maintained at considerably lower temperatures—possibly of the order of 62°—by such means.

It is suspected that there may be some relation between the relative percentage of radiant and convected heat and the optimum temperature for comfort—the comfort temperature becoming lower as the percentage of radiant heat increases, and conversely.

If this were demonstrated, such a relation would play an important part in

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the sizing of radiators with different systems of heating. It was brought out that the question is rather complicated by the fact that convection systems of heating usually maintain higher air velocities in rooms — the air velocity itself exercising a cooling effect—while the maintenance of a lower temperature than usual will automatically result in a higher relative humidity, which increases the sensation of warmth.

It was decided to seek the cooperation of the A.S.H.V.E. research laboratory, and such other research organizations as might be interested in such an investigation.

At the meeting held January 23, president-elect Kaiser declined the office, so that Otto E. Goldschmidt was elected president. John G. Eadie was elected vice-president and Alfred L. Jaros, Jr., secretary-treasurer.

Councillor Plan Organized to Aid Coal Retailers

Believing that the association can be of more assistance to individual retailers by maintaining a closer contact and by supplying them with important and practical information, the National Retail Coal Merchants' Association announces the "National Councillor" plan through Harry Turner, of Topeka, who will be in charge.

This comprehensive plan consists of having a representative coal man in each city of over 5000 population to be known as a National Councillor who will inform the national association what it can do to be of service to the local group, and who will pass on to his fellow coal merchants the information disseminated by the national association.

Goodwin Addresses New York Chapter of A. S. H. V. E. on Theater Air Conditioning

Samuel L. Goodwin, consulting engineer, spoke before the New York Chapter, February 16, on recent trends in theater air conditioning. Mr. Goodwin's remarks and the example he used to illustrate his talk referred largely to small theaters which cannot afford elaborate air conditioning systems. The speaker paid special attention to sound insulation.

The discussion was participated in by Walter Fleisher, H. L. Alt, Otto Armspach, and others.

Louis T. M. Ralston made a brief report for his committee on the New York City code but stated that the committee was still involved in negotiations with the city's committee. T. W. Reynolds reported for the committee in charge of the entertainment for the spring meeting, and said that the tickets would probably be three dollars instead of three and a half.

The members rose for a brief period in memory of Dwight H. Falkner, Jr., a member of the chapter, who died February 8.

Modernizing of Heating and Plumbing Urged

Suggested uses for plumbing and heating products play a prominent part in the odd jobs campaign of the President's Emergency Committee for Employment, one of the largest national advertising programs launched in recent years. A series of four advertisements, to appear during February and March, has been sent to a list of 2000 daily newspapers in all parts of the United States, urging readers to expedite construction and repair work within their own homes.

Under the caption "Put a Neighbor to Work," 100 typical jobs are listed, some of which, it is believed, should be applicable now to almost every house. Of the 61 suggestions which definitely indicate the use of building materials inside and outside the home, at least five definitely enter the plumbing and heating field and several others should open further opportunities.

The recommendations promoting direct use of plumbing and heating products are: renovate plumbing, heat the garage, renovate water supply system, rebuild water tanks, and renew sewage disposal system.

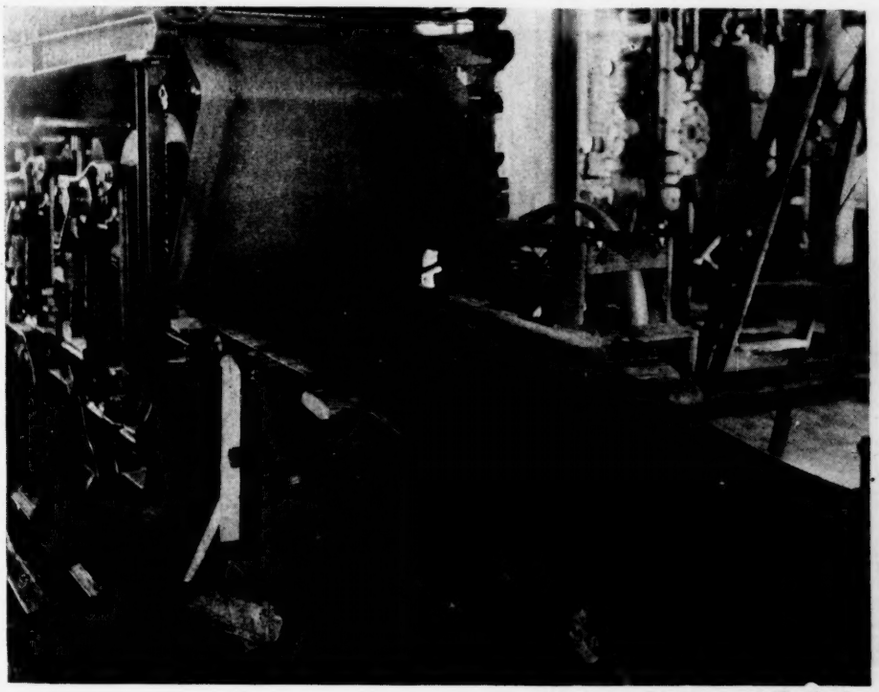
Oil Burning Boiler and Concealed Radiator Codes Adopted

At the Pittsburgh meeting of the A.S.H.V.E., two proposed codes were presented by committees for consideration, each of which provoked lively discussion at the time.

One code, which provides for testing and rating concealed gravity type radiation, lays down a proposed procedure in considerable detail. When the discussion made it apparent that some members felt that it would be very desirable to change many of the details the meeting finally took action accepting the code for use and referred it back to the committee for further study and report.

The code calls for conducting the tests inside a test booth of specified dimensions and sets up a method for both steam and hot water tests. It seemed to be the consensus of opinion that while the code was incomplete, it nevertheless offered a point of departure in developing a procedure which could eventually be made fully satisfactory.

The second code had to do with testing steam boilers burning oil fuel. This



Courtesy U. S. Bureau of Standards

Manufacturing Insulation from Corn Stalks

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code as presented by the committee not only laid down in considerable detail a description of the testing procedure and measurements, but also suggested forms for reporting such tests. Possibly the most distinctive feature of the proposed code lay in its provision for operating the burners both off and on. After considerable discussion this code was also referred back to the committee for further study and report.

Aims to Curb Smoke

Dr. Shirley W. Wynne, health commissioner of New York, is preparing for submission to the municipal assembly an ordinance for the licensing, by a special Bureau of Smoke Regulation, of all boilers, furnaces, and smokestacks constructed in the city, for the purpose of eliminating smoke.

The commissioner stated that he will present the ordinance to the Merchants' Association, the New York City Chamber of Commerce, and other civic organizations for consideration and possible suggestion.

Illinois Tests Coal Boilers

"Combustion Tests with Illinois Coals" is the title of Bulletin No. 213 of the Engineering Experiment Station, University of Illinois, prepared by A. P. Kratz and W. J. Woodruff. The bulletin reports the results of certain tests made in a water-tube power boiler stoker-fired using four Illinois coals. Test data and an analysis of the results are included. While a number of conclusions are drawn they are limited in application. 6 in. x 9 in., 60 pages, price 30 cents.

President Starts Gas Flow to District of Columbia

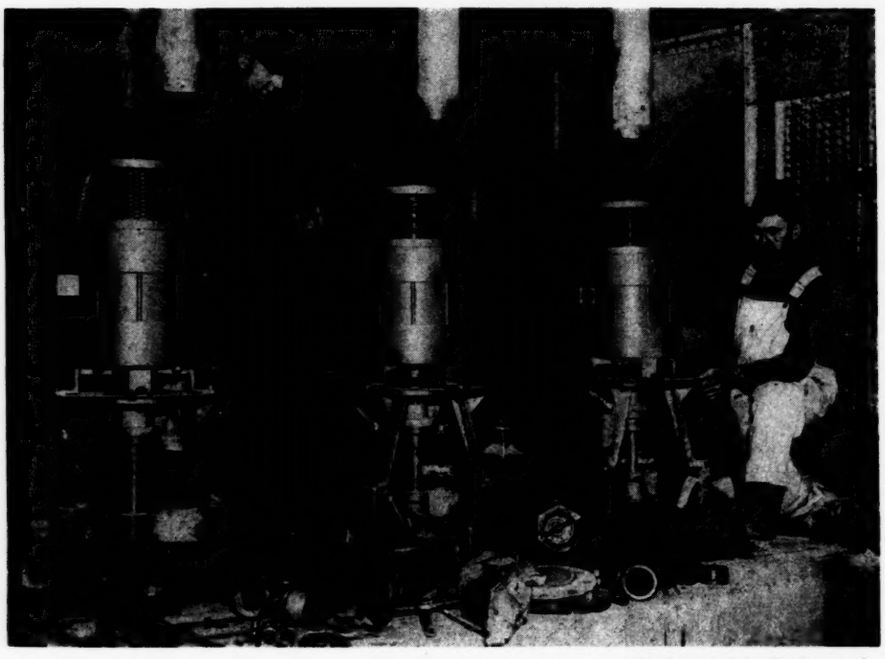
President Hoover pressed a button January 31 starting the flow of natural gas from West Virginia and Pennsylvania to supply consumers in the District of Columbia.

The pipe line through which natural gas will flow into the national capital is the first of a line to be extended along the Atlantic Seaboard for that purpose. Eventually gas will also be brought into Washington and the Eastern seaboard from Kentucky. It is estimated that the gas to be piped into Washington will be about 40% of the city's supply.

Form Welding Society in St. Louis, Mo.

The St. Louis Welding Society was formed at a meeting held recently in the Forest Park Hotel, St. Louis. This society, which consists of 65 charter members representing 26 companies in St. Louis, East St. Louis, and Madison, Ill., was the outgrowth of monthly meetings on the subject of welding, conducted by the Hill Equipment Engineering Co., St. Louis, representative of the Lincoln Electric Company. Temporary headquarters of the society were established at 4620 Delmar Boulevard, the home of the Hill company.

The following men were elected as officers: President, E. P. Barnes, Moloney Electric Company; vice-president, W. D. Patterson, American School of Welding; secretary and treasurer, Basil N. Osmin, Hill Equipment Engineering Company; directors, F. J. Feldhaus, Heine Boiler Company; Geo. Frankey, Alpha Tank & Sheet Metal Works; A. V. Fausek, Modern Engineering Company; Lyman Goodin, Midwest Piping & Supply Company; F. Tidwell, John Nooter Boiler Works; A. E. Edison, St. Louis Structural Steel Co.



Underwood & Underwood

Workmen Installing Battery of Pumps Which Will Circulate Cool Water from Underground Stream for Cooling New Commerce Building in Washington

Pittsburgh Contractors Entertain H. & P. C. N. A. Directors

The Heating and Piping Contractors Pittsburgh Association entertained the National Board of Directors and the headquarters staff of the Heating and Piping Contractors National Association at the William Penn Hotel, Pittsburgh, January 26.

James S. McVey, a former member of the board acted as master of ceremonies. President William Klie spoke on the necessity of stricter credit regulation in the building field. Henry B. Gombers, secretary emeritus of the national association, described some of the association's work in the days gone by. Harry M. Hart of Chicago described the apprenticeship system employed in his city and praised the foresight of those responsible for it.

Joseph C. Fitts, national secretary, discussed conditions in the industry throughout the country and S. Lewis Land, educational director, described the service his department was prepared to render the local associations. These talks were followed by a general discussion of the apprenticeship problem.

The 1931 budget for the association was adopted and the program for the forty-second annual convention was discussed and tentatively adopted. L. Lawrence DeNeille, chairman of the membership committee, told of the new membership campaign under way and submitted the names of twelve concerns for election to membership. He reported that so far St. Paul was in first place and New York in second place in the number of members obtained.

Joseph C. Fitts made a report on the work of the committee on standards. Upon recommendation of this committee the board adopted the following standards:

Proposed Revision of Commercial Standard for Wrought-Iron Pipe Nipples.

Proposed American Standard for Steel Base Fittings for 250, 400, 600 and 900 lb.

Proposed American Standard for Pipe

News of the Month

Plugs of Cast Iron, Malleable Iron, Cast Steel or Forged Steel.

Harry M. Hart reported on the work of the committee on boiler output. Since the last meeting of the board on October 6 and 7, 1930, new boiler selection sheets have been published. The committee is now considering the proper application of mechanical stokers, oil burners and gas conversion burners to heating systems.

Edward C. Byrd reported for the committee on certified heating and the direct mail advertising campaign sponsored by that committee.

John H. Zink reported for the committee on welding. The "Welding Manual" is in the hands of the printer and is in page proof form. Some delay has been experienced in getting final approval from the committee but now everything seems in shape for action and the committee expects to proceed with the printing.

The committee on boiler output met in Pittsburgh following the meeting of the board of directors. It reported that conferences had been held with boiler manufacturers to discuss the proper application of mechanical stokers, oil burners and gas conversion burners to heating systems. Prior to this time the work had been concentrated on hand-fired coal burning boilers. The extension of the program is to provide Certified Heating associations with adequate data on other methods of firing.

Air Conditioned Train to be Put in Service

It is reported that the Baltimore & Ohio Railroad has announced that it will equip a full train with air conditioning for service between New York and Washington. The Santa Fe, which has an air conditioned diner using the duct system for heating purposes as well as for cooling, reports that it has found the plant adequate except for extreme weather.

Second Midwest Coal Conference to be Held at Illinois

Announcement has been made that the Second Midwest Bituminous Coal Conference will be held at the University of Illinois, Urbana, Ill., May 21 and 22. An attendance of about 700 is expected.

The conference will bring together representatives of the coal, heating equipment, heating and piping, warm-air heating and power industries, and leaders in the fields of smoke abatement, engineering, education and general business, for scientific study of the convenient, smokeless and economical use of the product of midwestern coal mines.

This will be the second such conference. The first was held April 9-11, 1930, at Purdue University.

According to a tentative announcement, the official sponsors will be the University of Illinois, the Illinois State Geological Survey, Purdue University, Illinois Coal Bureau, Coal Trade Association of Indiana, National Association of Power Engineers, Fuels Division of A.S.M.E., Midwest Stoker Association and National Purchasing Agents Association.

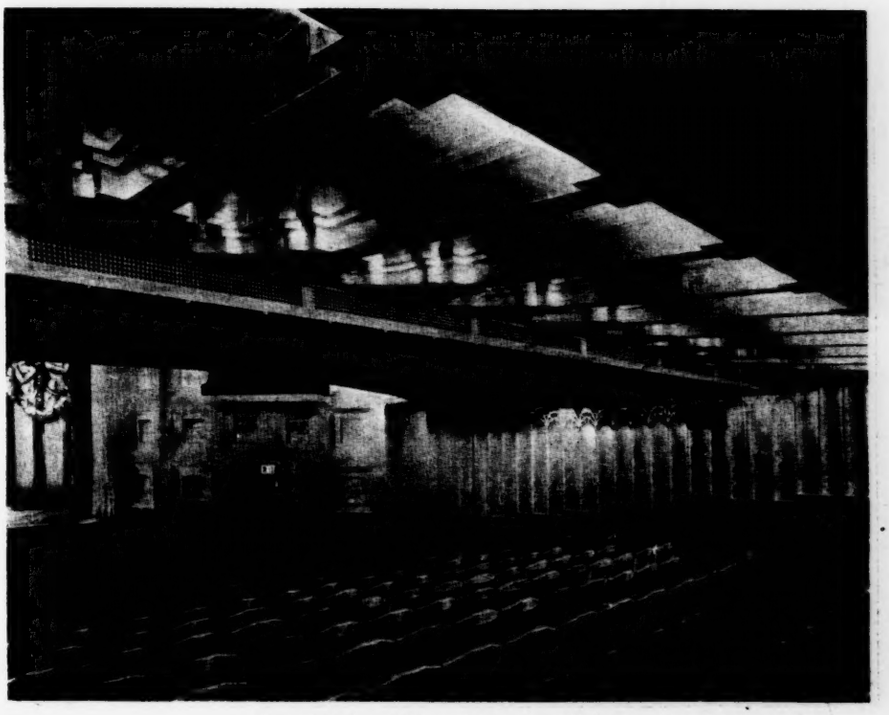
Detroit Engineers Talk on Office Building Heating and Power Piping

Detroit Edison Company was the host at the February meeting of the Michigan chapter of the A.S.H.V.E. This is an annual event and has become an outstanding occurrence in the annals of the chapter.

President E. E. Dubry opened the meeting by introducing S. S. Sanford, heating engineer with the Detroit Edison Company, whose subject was Modern Methods of Saving Heat in Buildings. Mr. Sanford has had charge of tests which have been run on more than a dozen office buildings in Detroit and the information which he presented was all based on the results of tests which he has run on these buildings. He brought out that in the average tall office building, it is safe to assume that the heat loss is proportioned as follows: 30% through the walls; 30% by infiltration and 40% through glass windows. He supplemented this statement by saying that the infiltration could be materially reduced if the windows were properly weatherstripped, and furthermore, that the 40% loss through glass windows could be reduced at least 60% if double windows were used.

From his tests he showed that in most tall office buildings not enough consideration has been given to the stack effect which exists in practically all cases. He urged that this be taken into account by increasing the heating surface on the lower floors and decreasing the radiation on the upper floors. He also brought out the fact, which is not generally known, that the upper part of a tall office building does not cool off at night as quickly as does the lower part of the building.

Mr. Sanford had charts to show that a great saving in steam consumption can be made in an office building if the steam is turned off at night. Contrary to the opinion of a large percentage of engineers, he has found that it is far more economical to turn off the steam as early as possible in the evening and leave it off until the following morning, turning it on then in sufficient time to bring the building to the proper temperature before it is occupied. In the first place, apparently the building does



From *Modern Picture Houses and Theatres* by P. Morton Shand, published by J. B. Lippincott Company.

Ventilating Grilles Under Balcony of the New Savoy Theatre, London

News of the Month

not cool as quickly or as much at night as the average engineer would expect and in addition, it is not as difficult to bring it up to temperature in the morning as the average engineer thinks it is.

These statements were confirmed by tests on office buildings which formerly kept steam on 24 hours a day and which during the last two or more seasons had turned off the steam at night.

Mr. Sanford went into the control of heating systems in office buildings, touching upon (1) Intermittent heating (controlled by thermostats), (2) Varying steam pressures or vacuum, (3) Fractional heating of radiators, by hand modulating valves, by wall thermostats or thermostatic radiator valves and by radiator orifices.

The speaker expressed the opinion that the radiator orifices were the best type of control where the system was controlled from a central point and the pressure was varied with the outside temperature. He said that actual tests showed that on a steam system with 3 lb. steam pressure and atmospheric pressure in the radiator, a ⅛ in. orifice will take care of 30 sq. ft. of radiation and a ¼ in. orifice will take care of 100 sq. ft. of radiation.

Following this very complete discussion, members N. B. Hubbard, J. H. Spurgeon, J. F. McIntyre, E. R. Harrigan and W. J. Whelan had questions which they asked the speaker.

The next speaker of the evening was J. H. Walker, superintendent of central heating and assistant to general manager of the Detroit Edison Company. His subject was Modeling as Applied to Pipe Design and Piping for Steam at 1000°.

Mr. Walker stated that some time ago they began to make a model of all the piping which is designed for their power plant. This model is made on a scale of ½ in. to 1 ft. and the piping is made out of wax. Mr. Walker stated that this came about inasmuch as it was very difficult for their engineers and draughtsmen to visualize the piping and they found that by making an actual model of the job, the installation of the piping was not only simplified but looked a great deal better. He illustrated this point by showing a picture of a unit with all its piping connections which had been installed before they began to make models and then he showed another picture of the same unit with its piping connections which were designed from a model, and even a layman could see that the second unit was simpler and better looking.

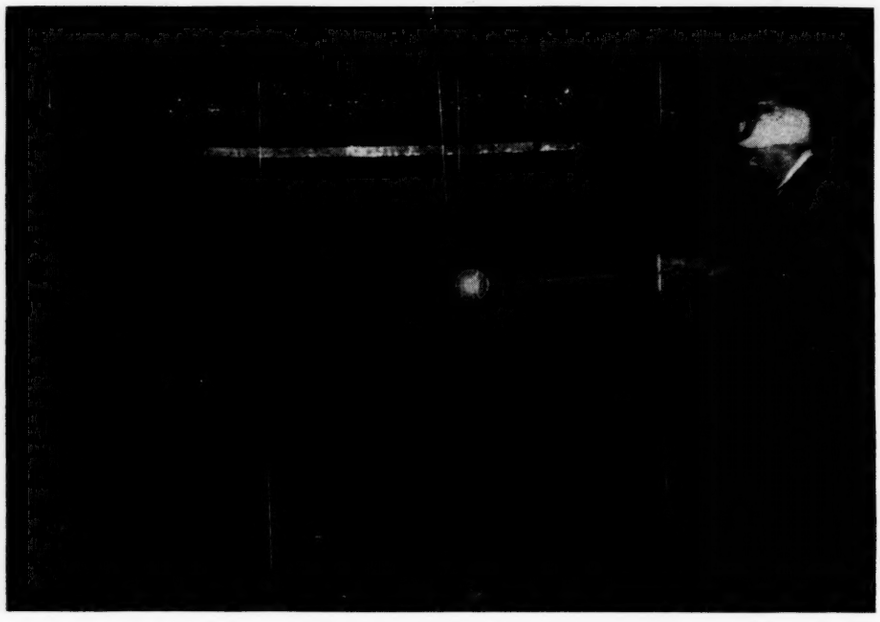
Mr. Walker brought out the fact that no 45° ells or angles are used if they can be avoided, and every precaution is taken to make a piping installation as clean cut as possible. He showed a photograph of the turbo-generator room in one of the Detroit Edison power plants, which indicated that there are six 50,000 kw. machines installed in this room and all of the units are identical. Standardization has been carried out as far as possible to make installation and operation as simple as can be.

In answer to an anticipated question, Mr. Walker stated that his company is using welded pipe on steam pressures up to 20 lb. but is advancing slowly in the use of welded pipe on the high-pressure steam until a more ductile weld is available.

Detroit Edison Company has long been recognized as a pioneer in power plant design and the latest development which they are carrying through is the use of steam at 1000°. Mr. Walker brought out the fact that at the present time, the maximum steam temperature which is used in most power plants does not exceed 750°. There are two general reasons why the company is developing this installation, using steam pressure of 1200 lb. and a temperature of 1000°. One is that by using this high temperature a certain percentage of condensation is eliminated as compared with using steam at a lower temperature, and second, a greater thermal efficiency is possible.

When it is considered that a temperature of 1000° is visualized as being at cherry red heat, it will be quickly seen that special pipes and joints are necessary. These pipes will be 18 and 8 nickel steel alloys and the joints and fittings will be a special design by the Detroit Edison Company.

An insulation 4½ in. thick will be used around the steam lines. The special joint which the company has developed is a welded joint backed up by bolted flanges on each side of the joint. It is anticipated that this installation of Detroit Edison will eventually lead to the use of high temperature steam in most power plants.



U. S. Bureau of Mines

Anemometer Employed in Pittsburgh Mine to Study Air Currents for Improving Working Conditions

Welding Economics Excites Discussion at Illinois Meeting

Due to illness, President Willis Carrier was unable to address the regular monthly meeting of the Illinois chapter of the A.S.H.V.E., held in Chicago, February 9. H. G. Thomas read the address made by L. A. Harding at the annual meeting of the society on heat and its effect on our cultural relationship under present economic conditions.

During the Question Box period, the subject of the minimum size of pipe which can be welded economically was discussed with considerable enthusiasm. While some felt that the minimum size was 6 in., others felt that 4 in. was more nearly the smallest diameter which might be economically welded. One member stated that his company's practice was to weld pipe 2 in. in diameter and in some cases below, not necessarily because of cost saving but for other reasons.

C. H. B. Hotchkiss spoke briefly on welding compounds. M. G. Harbula, a consulting engineer and formerly a member of the chapter, was introduced.

News of the Month

William Howe was presented with an electric clock in appreciation of his operation of the lantern for many years past. J. H. Schweim was elected to membership. The attendance was 58.

Patrick Gormly

Patrick Gormly, past president of the Heating and Piping Contractors National Association, died at his home in Norristown, Pa., on Wednesday, December 3, 1930. Mr. Gormly was 84 years of age.

Mr. Gormly was one of the organizers and first secretary of the Master Steam and Hot Water Fitters Association of Philadelphia, which was organized in 1889.

Dwight Hall Faulkner

Dwight H. Faulkner, sales engineer and technical adviser of the H. B. Smith Company's New York office, died February 8. Services were held February 10 at the home of his parents. Mr. Faulkner was born in Ashtabula, O., September 16, 1895. He entered Sheffield Scientific School of Yale University from which he graduated in 1916, with a degree of Ph. B. After graduation he returned for a year of graduate study.

During the war, Mr. Faulkner was in the employ of the government, engaged in the manufacture of Liberty Aeroplane Motors. He was at one time with the Yale & Towne Manufacturing Company in their experimental and research department, and was also engaged in the development of the Diesel engine.

He was an associate member of the A.S.M.E., a member of the A.S.H.V.E., and a member of the Yale Engineering Association and the Yale Club of New York City.

He also was president of the Dissolene Corporation and vice-president of the Anthracite Coal Service.

He is survived by his wife and two children.

Frank E. Wheeler

Frank E. Wheeler, president of the International Heater Co., Utica, N. Y., since its organization and a leader in manufacturing and banking circles in that city for many years, died at his home, February 17, after an illness of a fortnight.

Mr. Wheeler was born in Utica, April 9, 1853, was educated in the public schools, and graduated from Yale in 1876. In 1877 he became a partner of his father, Russel Wheeler, in the foundry on Columbia Street, and the firm became Russel Wheeler & Son. The establishment, a large one, made warm-air furnaces, hot water and steam boilers, ranges and stoves.

Russel Wheeler died in 1895, but the business continued under the firm name until 1898, when it was sold to the International Heater Company.

Mr. Wheeler succeeded his father in several other positions of trust. He had been a director in the Savings Bank of Utica since 1895, and was also a director in the Utica Trust & Deposit Company. For many years he was director and vice-president in the Utica Steam & Mohawk Valley Cotton Mills.

He was a descendant of Lazarus Wheeler, who came as a pioneer from Glastonburg, Conn., with his 11 children, making the entire journey and conveying his household goods as well as his family by means of ox team. Lazarus, the original settler, died in 1851 at the age of 92, and his son died at the age of 91. He is survived by one daughter and two sons.

Kennard Appointed McMillan Fellow at Bureau of Standards

Dr. Ralph B. Kennard, formerly head of the Physics Department of Robert College, Istambul, has been appointed a research associate of the Bureau of Standards, Washington, D. C., for research work in accordance with the provisions of the Luther B. McMillan Fellowship.

The privilege of establishing and maintaining this fellowship as a memorial to the late Luther B. McMillan was accorded the Johns-Manville Corporation by the Director of the Bureau of Standards shortly after the untimely death, in August, 1929, of Mr. McMillan, consulting engineer for that company and a pioneer in research in heat transfer problems.

Dr. Ralph B. Kennard

Associate research work to be conducted by Doctor Kennard will cover fundamental problems involved in the transfer of heat between solids and fluids.

Doctor Kennard, before joining the staff of Robert College, was connected with the University of Chicago, where he received his doctor's degree in physics. Previous to this he was head of the Physics Department of Shanghai College, Shanghai, China.

Coming Events

March 11-12, 1931. Spring meeting of the Eastern Supply Association. Headquarters at the Hotel Astor, New York.

March 25-26, 1931. One Hundred and Sixth Regular Meeting of the Central Supply Association, to be held in Chicago. Headquarters at the Palmer House.

April 13-18, 1931. American Oil Burner Association Convention at Philadelphia. Headquarters at the Benjamin Franklin Hotel.

May 6-8, 1931. Spring Meeting of the American Society of Refrigerating Engineers at Kansas City, Mo. Headquarters at the Hotel President.

May 6-9, 1931. Annual Convention of Heating and Piping Contractors National Association at Louisville, Ky. Headquarters at the Kentucky Hotel.

May 21-22, 1931. Second Midwest Bituminous Coal Conference, at the University of Illinois, Urbana, Ill.

June 2-5, 1931. Annual Convention of the National District Heating Association in Boston. Headquarters at the Hotel Statler.

June 8-11, 1931. Annual Convention and Informashow of the National Association of Purchasing Agents in Toronto, Canada. Headquarters at the Royal York Hotel.

June 22-25, 1931. Forty-Ninth Annual Convention of the National Association of Master Plumbers, to be held in Milwaukee, Wis. Headquarters at the Milwaukee Auditorium.

June 23-26, 1931. Summer Meeting, American Society of Heating and Ventilating Engineers, at Swampscott, Mass.

July 13-17, 1931. National Association of Building Owners and Managers. Headquarters at the Olympic Hotel, Seattle, Wash.

November 30-December 5, 1931. First National Exposition of Mechanical Handling at the Grand Central Palace, New York.

Correspondence

Steam Load Follows Degree Day Curve in Apartments in New York Suburban Territory

EDITOR HEATING AND VENTILATING:

In the November issue of HEATING AND VENTILATING appeared an article by John W. Meyer of the Philadelphia Electric Company. In that article under the caption "Maximum Demand" there is a reference to Table 3 which apparently indicates that the steam consumption does not vary with the degree days.

The writer, believing that the following data might be of interest, has taken the liberty of submitting herewith a set of curves based on the actual measured condensation of 16 apartment-house and community-group buildings covering a period of time sufficiently long to obtain a fair average.

These curves indicate, in the writer's opinion, that the steam consumption on any given building or buildings does tend to follow the curve of degree days in direct proportion as control of steam supply is effectively regulated.

Curve A is degree days in this vicinity. Curve D is the theoretical steam consumption based on a heating factor remaining constant at 5000 lb. per degree day (for these particular buildings).

Curve B is the actual steam consumption as measured by condensation meters.

Curve C is the heating factor in pounds of steam per degree day (ratio of curve B to curve A).

The shaded portion between curves represents, of course, the loss due to overheating.

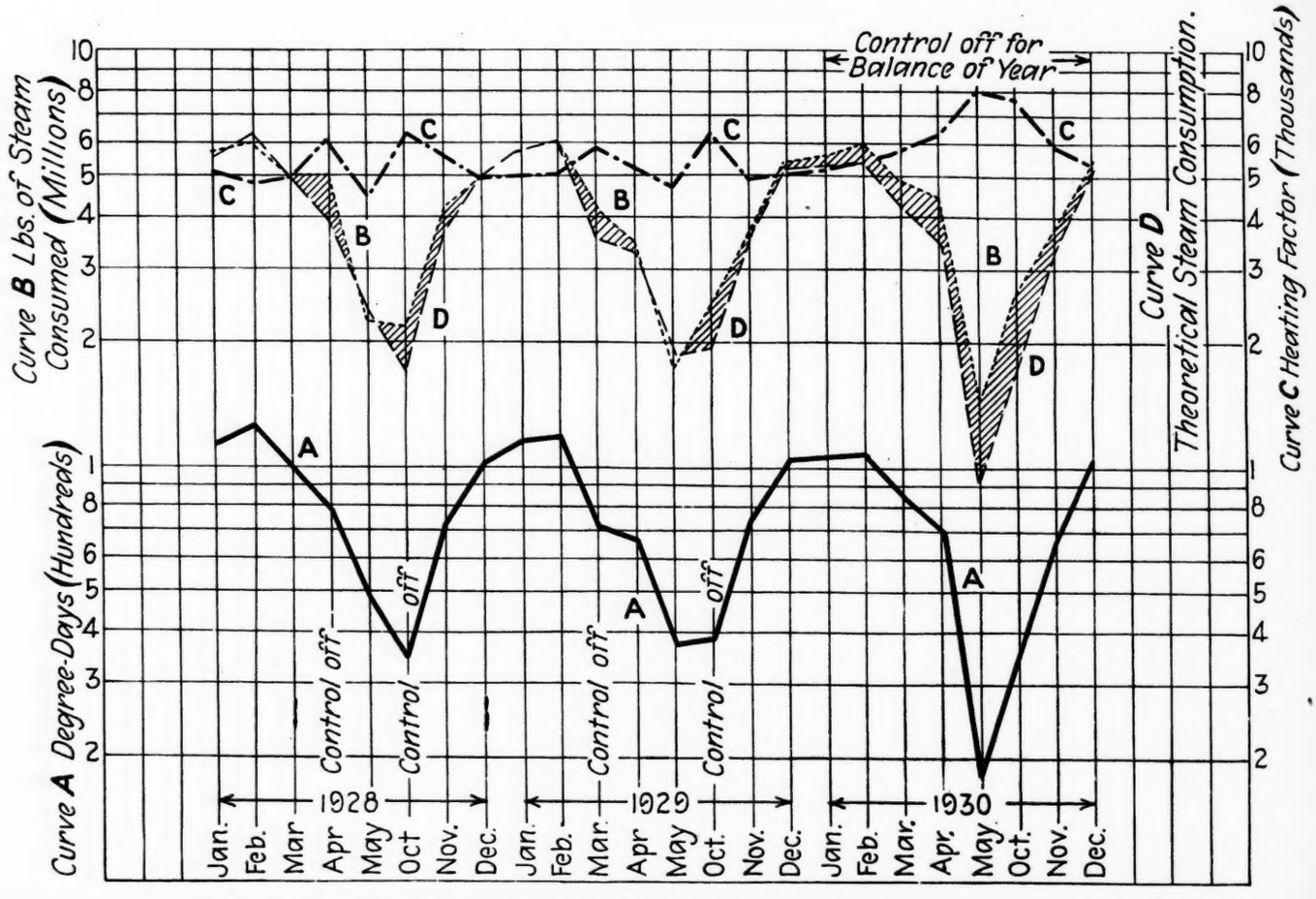
During 1928 and 1929 attempts were made to control steam to these buildings in accordance with outside temperature variations except as noted on the graphs. During 1930 control was discontinued entirely for the whole season in order to obtain a complete check upon the variation in the heating factor. It is interesting to note the increase in the heating factor as the season progressed through the mild months. The writer has not drawn the outside temperature curve in order to avoid congestion, but it can be stated that the variation of the heating factor tends to follow the outside temperature curve when control of steam is not exercised.

One point the writer wishes to stress is that all steam consumed in a building for other than strictly heating purposes should be excluded from any data compiled and if this is done the steam consumption curve should follow the variation in the degree day curve as mentioned in a preceding paragraph.

A secondary point of interest, perhaps, is that of the 16 buildings included in this data, 7 are return line vacuum; 7 are single pipe gravity; 1 is two pipe gravity and 1 is two pipe orifice. The steam consumption per degree day per square foot of radiation in individual buildings varies from 0.077 lb. to 0.172 lb. From this it may be judged that a fairly representative group of buildings is included in the above data.

P. W. REYNOLDS

The Lawrence Park Heat,
Light and Power Co.,
Bronxville, N. Y.



Degree Days, Unit Steam Consumption, Actual and Estimated Demand for Sixteen Apartment Houses

Correspondence

A Problem in Ventilation

EDITOR HEATING AND VENTILATING:

Recently, I happened to be called into a hotel room. The call came from a woman guest who had been sick for about a week. She claimed that in rising in the morning her breath seemed to leave her. Her lungs felt congested. First I was prone to attribute this to her illness, but on further consideration, I felt there might be something more to it.

There was a ventilator in the bathroom connected to a suction fan on the roof. I closed the bathroom door and put a piece of paper at the bottom near the tread and it acted as if it were in a whirlwind.

This solved the mystery. The woman was right, as they sometimes are. She had kept her apartment closed tight, fearing a draft, and the suction fan did the rest.

This is but one of many similar cases in hotels, etc., where greater care should be used and more engineering skill exercised to protect the unwary public. Fresh air bugs may even be affected in the winter time by tightly closed rooms.

It is wrong to displace air without some automatic means of supplying it.

So-called dead ducts could be installed in remote places that would take care of dead air and equalize the air pressure at all times.

L. K. ELLSWORTH

New York, N. Y.

Heating Economies in Montgomery Ward Buildings

EDITOR HEATING AND VENTILATING:

As an occasional reader of HEATING AND VENTILATING, I have been very much interested in the questions put to your readers in the November article on heating the Montgomery Ward buildings and the correspondence on this subject in the January issue. Upon re-reading the test data given in the original article, I find a number of interesting points in addition to the two questions put to your readers.

Your question No. 1 is answered by the figures given in the body of your article. Observed temperatures (I assume these are averages for the 48-hour test) are 3.8° high, and you state that "it was not possible to create a steam main pressure of 2 lb., which is the design pressure of vacuum return line systems." If the system was operated during test at lower supply pressures than normal, and room temperatures still averaged 3.8° above the desired temperature, what else remains as a control of inside temperatures but intermittent operation?

Your second question sounds odd to me. "Irrespective of whether or not No. 1 is true," you say. If a vacuum return line system could be maintained at 70° F. inside temperature, there is no need to consider anything but 70° as the basis for degree day calculations. If the vacuum return line system cannot be maintained at 70° inside temperature, are we to assume that this changes the normal requirements for comfort of the occupants, and that because this system cannot meet the normal figure of 70° the basis of calculations must be changed to something that the vacuum return line system can meet?

If you are a vacuum return line man, why change the base figures? If you're an innocent bystander comparing performance, do it on the standard basis. The standard for comfortable inside temperature has been set at 70°, probably taken as an average figure between 68° and 72°, the practical range which covers individual requirements of the majority of people. The standard outside temperature of 65° has been set by competent authority as being the outdoor temperature above which heating is not required. Anything lower than 65° F. outdoors is a gauge of the amount of heating required within the building.

With these figures of 70° normal inside and 65° base line outside we have an equitable basis for comparison of heating system performance by the degree day method of calculation.

Introducing any other variables, or corrections in the calculations, merely fogs the issue. Character of fuel, combustion efficiency, boiler condition, etc., all affect the cost of operation, but have nothing to do with a comparison of heating systems during tests where every effort must be made to hold these factors constant for both halves of the test. It does not matter what those factors are, so long as they do not vary while the tests are on.

Your calculation by which the saving made by the differential system is reduced to 27% is another point which interests me. Examine the test data and you will see that during the differential system test 49,665 lb. of coal were fired. During the vacuum return line test 70,918 lb. of coal were fired. These figures alone show practically 30% saving made by the differential system.

Now, let us examine the variables to see what causes this 30% saving.

Duration of test is the same, 48 hr. for each system.

Inside temperatures are 70.2° for differential, 73.8° F. for vacuum return line, which shows where some of the extra fuel went, but cannot be charged against the differential system, since what we want is 70° inside temperatures.

Outside temperatures were 30.87° during differential run, 33.04° during vacuum return line run. Actually the outside temperatures were higher during the vacuum return line part of the test, requiring less heat inside, and, it seems to me, requiring less fuel rather than more.

So far we have nothing to require an adjustment downward of the differential system showing. On the contrary, the colder outside temperatures during the differential run justify an allowance which would increase the percent saving above the 30% in actual coal burned. Yet in your note you wish to give an allowance to the vacuum return line system because of one of its inherent defects—overheating.

Thus, there is nothing on these figures to explain the 30% difference in fuel as fired. The differential system operated better (held 70° inside temperature) and used less fuel by nearly one-third. The difference in inside temperatures explains the situation, of course, since we all know by now that over-heating wastes fuel, and fluctuation of inside temperatures wastes fuel, and poor circulation wastes fuel.

E. H. VERRALL

Evanston, Ill.

Heating Industrial Buildings with Gas

(In his article on Gas as a fuel for heating industrial buildings in the December issue of HEATING AND VENTILATING, C. George Segeler, industrial engineer of the American Gas Association, showed the application of the industrial degree day to problems involving estimates of gas consumption. A 14% decrease in fuel consumption was mentioned when the building was maintained at 45° instead of 50° at night. Mr. Segeler's letter explains the origin of the 14%.—*Editor*)

The 14% decrease is easy to arrive at. The charts were based on a night temperature of 50°, and the actual temperature in the illustration which I picked was to be 45°. In figuring out the 14% I worked as follows: The normal heating season is 210 days, but a 55° day season would have 5/6 as many days approximately, which gives 175 days. This, divided into 4122 degree days, gives an average temperature of 24°. Subtracting this from 50°, we have 26°

Correspondence

difference. A 5° saving in 26° amounts to 19.3%, but the heating is only 14 out of 24 hours, so the saving comes out to about 11%. When I actually worked the problem, I had the data in front of me on the true average temperature. This was considerably higher than the figure of 24° which I just worked out for you, and consequently the final saving came out to 14%. Just for the moment, I can't lay my hands on the actual winter temperature for the location in question.

C. GEORGE SEGELER

New York, N. Y.

Differential Vacuum Heating Systems

EDITOR HEATING AND VENTILATING:

Referring to Sterling S. Sanford's letter in your issue of January, 1931, regarding heating economies in the Montgomery Ward buildings:

Such a differential vacuum heating system as is suggested and described in Mr. Sanford's letter would embody features of construction and operation which characterize the Dunham differential heating system covered by Dunham patents, and installed in the Montgomery Ward buildings.

Your readers should be advised that any installation and operation of a heating system as described by Mr. Sanford would certainly involve them in a suit for infringement of our patents, among which we particularly call attention to Dunham Patent No. 1,644,114.

What Mr. Sanford describes as a "vacuum return line" system is a Dunham differential system as installed in the Montgomery Ward buildings, outstanding features of which are pressure reducing valves in the supply main, whereby steam is furnished to the radiators at a high vacuum, "a fixed orifice in the inlet to each radiator" through which the flow is varied by varying the vacuum in the steam main, a high vacuum in the return, and a maintained, constant difference in pressure between supply and return mains.

Your readers are not at liberty to use such a system. Any such reconstruction and operation of a vacuum system will involve infringement of our patent rights. If any reader has any doubt about this, he should obtain the opinion of competent counsel before operating such a system with a variable vacuum.

C. A. DUNHAM

President, C. A. Dunham Co.

Chicago, Ill.

EDITOR HEATING AND VENTILATING:

I submit the following comments regarding C. A. Dunham's letter.

In referring to differential pressures in the vacuum system, the writer did not have in mind the conception of pressure differential which is the basis of the Dunham system. He was merely referring to the natural pressure drop which is present in any heating system of whatever kind when there is a flow of steam through the system. He did not recommend the maintaining of any definite differential pressure but definitely stated that "the proper method of operation is to run the vacuum pumps continuously so that they will provide in the returns the maximum vacuum of which they are capable." The pressure *in the radiators* is to be adjusted according to the prevailing weather conditions. He was not attempting to describe a system having any features additional to those which characterize hundreds of vacuum heating systems throughout the country.

Use of a variable sub-atmospheric pressure in radiators as a means of varying their heat output is not new and was in use many years prior to the application date of Mr. Dunham's patent No. 1,644,144, February 28, 1927. The use of sub-atmospheric pressure in radiators has been recommended by The Detroit Edison Company to its steam heating customers since 1923 and has been used by the company in its Service Building at 2000 Second Ave., Detroit, continuously since 1921.

In the 1923 proceedings of the National District Heating Association, a description of the suggested method is given on page 191 and following, by J. Earl Seiter, who was then associated with this company. In the following pages of those proceedings the results of tests on certain buildings are given, showing the savings in steam consumption obtained. In 1924, similar data were given in a paper by N. W. Calvert and J. E. Seiter, entitled "The Economical Utilization of Heat from Central Stations," presented before the American Society of Heating and Ventilating Engineers.

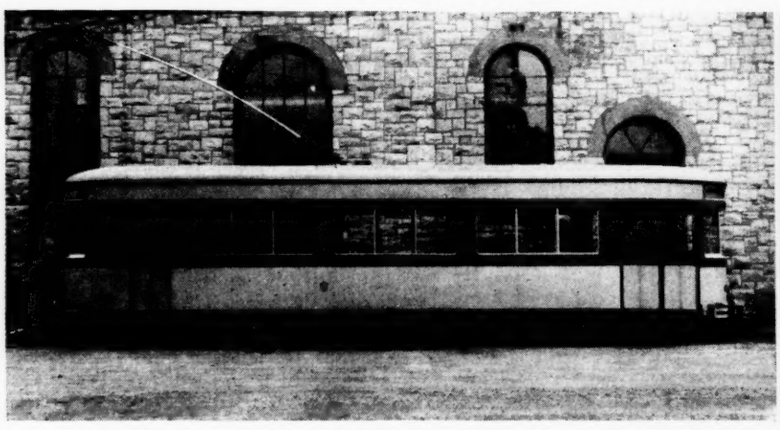
The method advocated in these publications and used by The Detroit Edison Company does not require, nor has there been used with it any special equipment other than that which has been used in heating systems for a great many years. The method is simple in operation and has resulted in considerable saving.

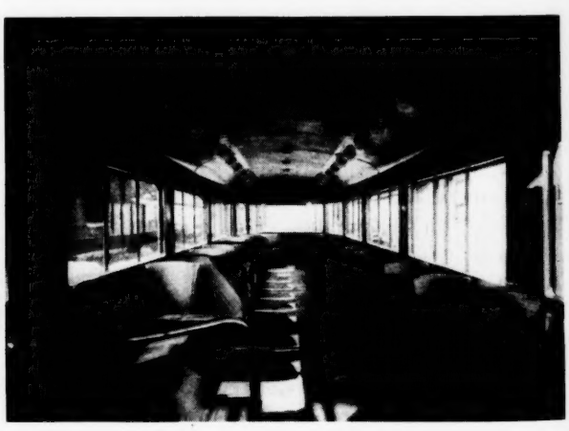
Many variations have since been recommended by others, and special equipment has been devised which is doubtless of some merit. The writer does not at this time question the validity of any patents covering these special devices nor the merit of the devices themselves. However, the prior use of the fundamental idea of sub-atmospheric radiator pressures by The Detroit Edison Company would seem to indicate that the essential principle involved is not controllable by patents which may have been issued subsequent to its successful use by the company.

S. S. SANFORD

The Detroit Edison Co.,

Detroit, Mich.





New Street Coaches of the Chicago and Joliet Electric Railway Company Provided with Mechanical Ventilation and Electrically Heated

Estimating Oil Consumption on the Degree Day Basis

For a steam heating system designed to maintain 70° F. inside temperature in zero weather, 0.0006857 of 140,000 B.t.u. per gal. oil are required per square foot of radiation per degree day when the system operates at 100% efficiency.

It is necessary to correct this unit figure for designed temperatures other than 0—70°, for heating values other than 140,000 B.t.u., for efficiencies other than 100%, and for hot water systems, provided the latter type of system is installed.

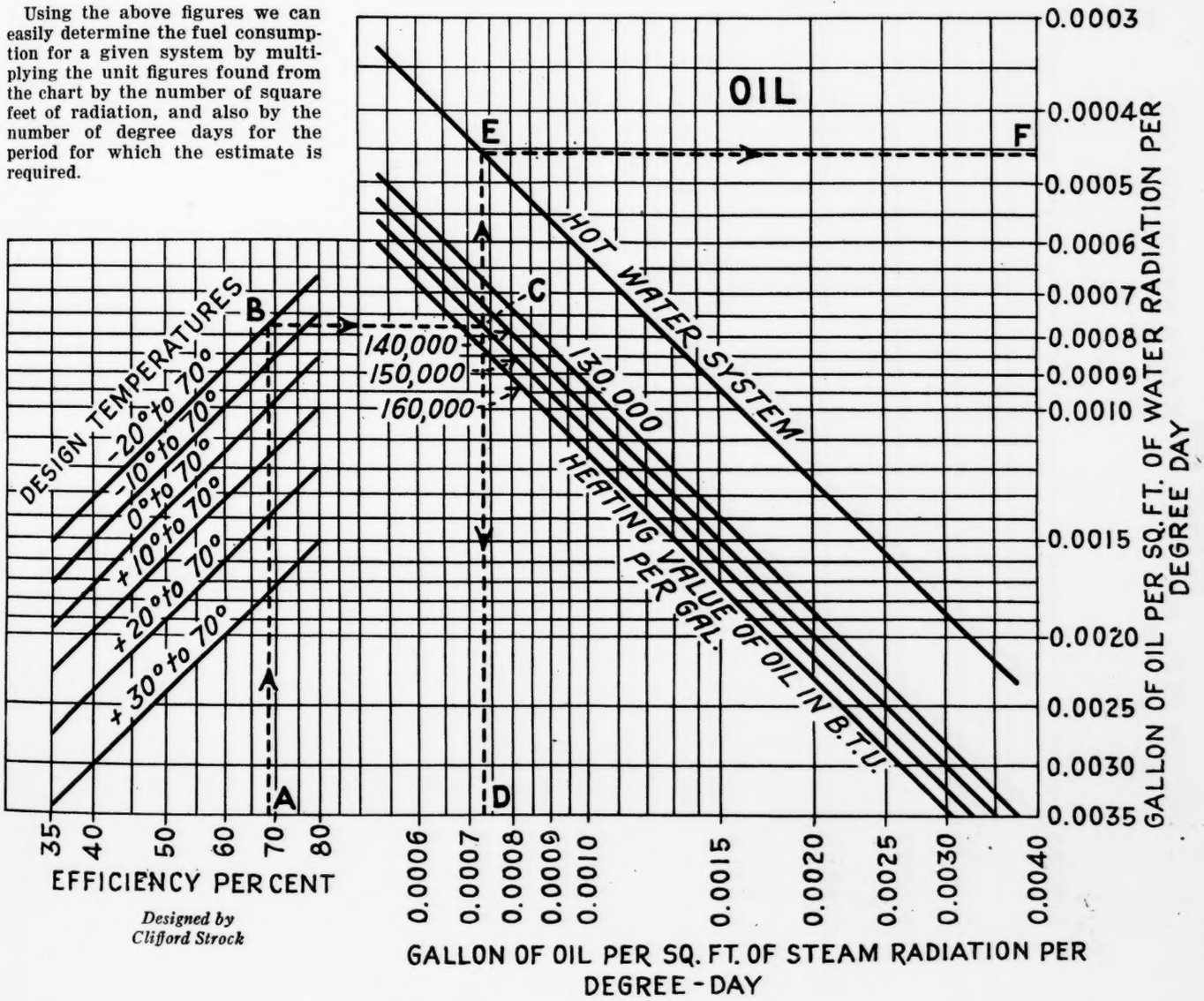
Based on the above, the corrections can be made by using the accompanying graph, which will give the number of gal. of oil required per square foot of either steam or water radiation per degree day.

Assume that an oil-fired heating system is operating at a seasonal efficiency of 68% in a city where the heating plant was designed to maintain 70° in 20° weather; and that the system is burning an oil with a heating value of 150,000 B.t.u. per gal. What is the oil consumption per square foot of steam radiation per degree day? Per square foot of water radiation per degree day?

This problem is solved by the use of the oil chart. Locate the efficiency, 68%, on the efficiency scale at A. Through the point where this line intersects with the designed temperature,—20°, at B, draw a horizontal line to the heating value of the oil, 150,000 B.t.u. per gal. at C. Draw a vertical line downward and we find at D that 0.00073 gal. of oil is required per square foot of steam radiation per degree day.

In the case of a hot water system, the upper scale is used, and instead of dropping downward from C to D, draw a vertical line upward from C to E, the point where the line intersects the curve labeled Hot Water System. Then proceed horizontally to the upper right hand scale where we find that 0.00046 gal. of oil is required per square foot of water radiation per degree day.

Using the above figures we can easily determine the fuel consumption for a given system by multiplying the unit figures found from the chart by the number of square feet of radiation, and also by the number of degree days for the period for which the estimate is required.



Designed by Clifford Strock

Heating and Ventilating Data Sheet No. 5-V

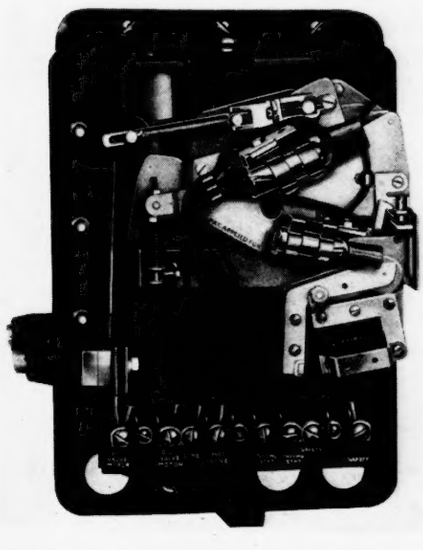
Degree Day Charts—Estimating Oil Consumption

New Apparatus and Appliances

Oil Burner Control Eliminates Radio Interference

Announcement has been made by the Mercoid Corp., 4201 Belmont Ave., Chicago, Ill., of the type TU safety control and constant current incandescent ignition control for automatic fuel burners. The unit was developed to meet a demand for a control which would incorporate ignition means which will eliminate radio interference and to provide electric ignition for certain types of burners for which other ignition methods might be unsuitable.

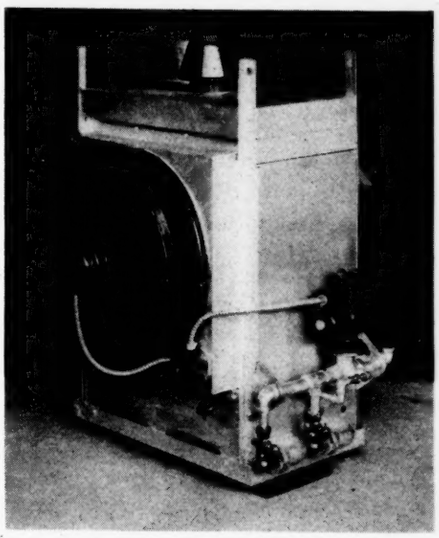
The control is said to have thirteen important features, five of which are: (1) Fuel cannot enter the combustion chamber unless the igniters are in circuit and at the required temperature. (2) When the igniters are at the required temperature only a limited amount of fuel can enter the combustion chamber unless combustion takes place. If combustion does not occur within the predetermined period during which it must actuate the Mercoid Pyratherm safety switch, a shut-down occurs, requiring a manual reset. (3) If for any reason the flame should fail after combustion has taken place, the burner will shut down and, after a period of rest, will automatically attempt again to initiate combustion. (4) Upon interruption of current supply this control will immediately shut down the burner and after a period of rest and upon restoration of the current will automatically attempt again to initiate combustion. (5) The Mercoid Pyratherm Control, after every operation, must return to the cold "off" position before another operation can be effected.



Mercoid TU Ignition and Control System

Pittsburgh Gas Unit Heater

The Pittsburgh gas-fired unit heater has been announced by the Automatic Gas-Steam Radiator Co., 301 Brushton Ave., Pittsburgh, Pa. A copper-tube radiator coil is used with cast iron headers and combustion chamber. Although heavy sheet metal deflectors are employed, the products of combustion come in contact with only cast iron or copper surfaces.



Pittsburgh Gas Unit Heater

An automatic electric gas valve shuts off the gas supply when the fan is turned off. Thermostatic control can be attached to make the unit completely automatic.

The unit has an input rating of 100,000 B.t.u. per hr. with an air volume of 1800 c.f.m.

Panels Have Insulating Properties

In the accompanying illustration, C. R. Mahaney, engineer in charge of the development of Micarta for the Westinghouse Electric and Manufacturing Company, points out the perfect matching of the hard and relatively inexpensive Westinghouse wonder wood

Micarta Used as Paneling

used as paneling in the living-room of his recently completed home in the suburbs of Pittsburgh, Pa.

These panels, produced at a fraction of the cost of natural wood, are so hard that their finish is not injured by water or other cleaning agents.

A thin surface of the wood, mounted on wallboard, is set in place like ordinary paneling. Since neither is affected by moisture, there is no warping. Because of insulating qualities, this paneling keeps the living-room warm in winter and cool in summer, and deadens the passage of noise.

Tests over long periods of time have shown that the surface will not stain, crack, or peel. The panels can be cleaned by soap and water without the slightest harm. They are capable of withstanding without injury temperatures above the heat of boiling water.

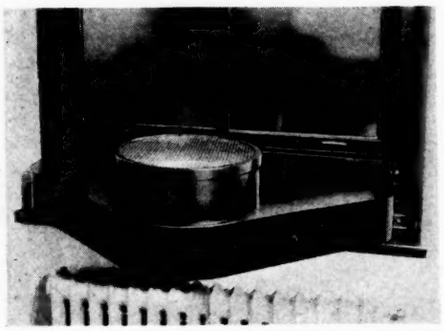
Maxim Window Ventilator

A window ventilator and silencer has been announced by Hiram Percy Maxim. The device consists of a Maxim Silencer and an electric fan. The Silencer is a flat box with no moving parts, some 5 in. high. The electric fan furnishes ventilation only, and is arranged in a circular box 6 in. high. One only has to lift the latter to the building, shut the window down and connect the electric cord to the most convenient outlet, and the installation is done. A switch controls the electric motor which runs the fan. Thrown one way, the Silencer draws air in from outdoors, and blows it straight up into the room. When the switch is

New Apparatus and Appliances

thrown the other way, the fan blows air from the room outdoors.

The motor consumes the same amount of electric power as a lamp bulb. Filler blocks insure a noise-tight fit between the sides of the Silencer and the window



Maxim Window Silencer and Ventilator

frame, and also for the space at the joint between the upper and lower window sashes.

Holcomb & Hoke Announce Domestic Stoker

A domestic stoker has been placed on the market by the Holcomb & Hoke Mfg. Co., Indianapolis, Ind., under the trade name H. & H. One of the features of design is the hopper gas eliminator which takes gas from the throat and draws it back over the fire to prevent gas from coming out of the hopper.

The stoker has a separate fan unit. In locations where quiet operation is essential, the unit is housed in a special compartment insulated against noise. The coal feed control allows 13 different feeds.

The gear assembly is simple. Noiseless continuous drive eliminates ratchets and gear shifting mechanisms. The four gears run in a bath of oil, and all of the case except the lid is in one piece, assuring freedom from oil leakage.

A narrow retort and specially designed screw keep the coal on the move, prevent clogging of air openings and make possible thorough mixing of coal and air. High tuyeres insure proper slag drainage, making it possible to burn low-priced stoker coals. The retort is tilted slightly to one side to compensate for the torque of the feed screw to insure an even distribution of coal and thus a perfect fuel bed.

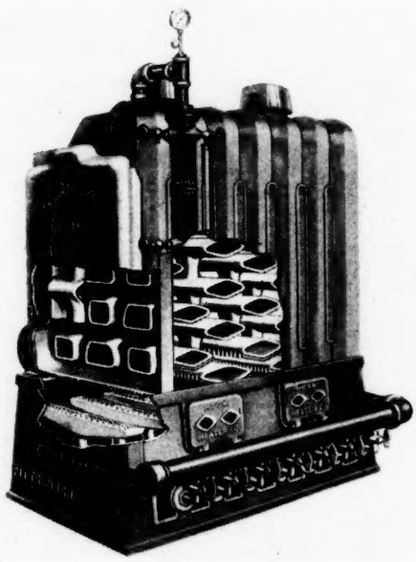
The feed screw is designed to withstand high temperatures, corrosion and abrasion.

As a safety measure to eliminate any possibility of burning out the stoker when the screw becomes jammed from foreign matter in the coal, the stoker uses a special overload cut-out relay which disconnects both motors, shutting off the coal feed and the blower immediately. Oversize gears, bearings and shaft provide a factor of safety great enough to stall the drive motor.

Hook Gas Boilers

A line of sectional gas boilers and a line of water-tube jacketed gas boilers are being sold by the Hook Heater Co., Sharpsburg Sta., Pittsburgh, Pa.

The H & M series of unjacketed boilers are designed for industrial and commercial buildings. The water tubes are of diamond shape cross section, the bottom sections of which are finned to increase the radiant heating surface of the bottom tubes.



H & M Series, Hook Gas Boiler

In the design of the gas-burning equipment, the mixer and gooseneck are cast in one with the mixer throat. The mixer shutter is adjustable to provide primary air inlet around the entire circumference of the mixer. The burners reach the full length of the section tubes, with the burner ports raised to provide secondary air at each tip. The cleanout panels fit between sections, and are easily removed. This line of boilers is available in 29 sizes, with net capacities ranging from 195 to 4490 sq. ft. of steam radiation.

The jacketed boilers are designed for residence heating installations, and are finished in a deep maroon with the jacket of acid and rust-resisting metal, lined with one inch of insulation. The bottom of the sections in this line are also ribbed or finned. The ends are water jacketed to reduce heat losses and to prevent the burning of paint on the jacket. Burner and section design is similar to that in the H & M series. The jacketed boilers are available in 27 sizes, with net capacities ranging from 295 to 4380 sq. ft. of steam radiation.

Van Fleet Boilers

Announcement has been made by the Sharp and Van Fleet Mfg. Co., 285 East Blackwell St., Dover, N. J., of the Van Fleet heating boiler.

Condensation or return water enters the unit about three-quarters of the height of the boiler from the bottom, and is preheated. The preheated water enters the unit at the bottom length of the section and passes through to the steam dome without coming in contact with the water in the preheated unit. 80% of the water in the boiler is in the preheated unit, the remaining 20% being in the generating unit.

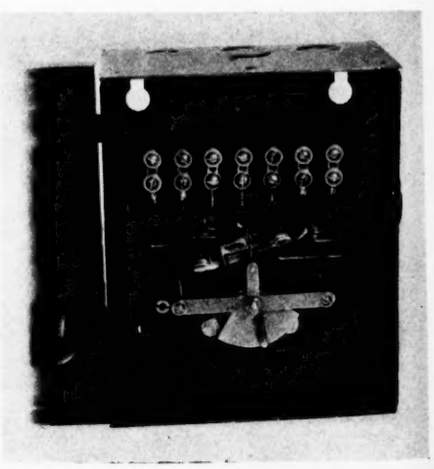
The unit, which is made of cast iron, is available in two sizes of grate, 13 in. and 18 in. wide and in lengths sufficient to give grating ranging from 300 to 1000 sq. ft. of radiation.

Stat-Amatic Relay

The Stat-Amatic Instrument & Appliance Co., Hartford, Conn., recently announced a relay, the function of which is to protect the contacts of control instruments. Its applications include the operation of unit motor heaters, stoker motors, etc.

The illustration shows the three important parts of the relay, (1) the two actuating coils, (2) the mercury tube which carries the main operating circuit, and (3) one of the two short circuiting contacts that are mounted immediately on the bakelite base and behind the mercury tube.

When the control circuit to the relay is closed by the thermostat, thermoregulator, or some other sensitive instrument, one of the coils is energized, pulling the armature, on which the



Stat-Amatic Relay

New Apparatus and Appliances

main circuit tube is mounted, over to it. This action not only "makes" or "breaks" the main circuit in the mercury tube, but at the same time operates one of the short circuiting contacts which immediately shunts out the control circuit. It will thus be seen that none of the main current is permitted to flow through the thermostat or control instrument contact, nor are these contacts permitted to "break" the main circuit.

Oil-O-Chron Heat Regulator

The Oil-O-Chron heat regulator has been placed on the market by the Oil-O-Chron Sales Co., 1 Beacon St., Boston, Mass. The regulator differs from other systems of thermostat and pressurestat control in that the amount of heat radiated is controlled not by the amount of radiator surface heated, but by the length of time a definite, constant and known radiator area is radiating heat. In thermostat and pressure controlled systems, the radiators may be heated all the time, but when little heat is required the radiators have often only a vapor pressure, and may or may not be warm, depending upon many conditions which have no effect when a good steam pressure is present.

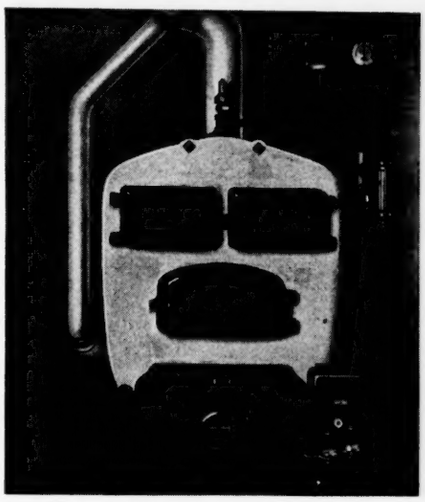
The periods of heating are usually for fifteen minutes, spaced by desired intervals in which there is no heating. The figures show schematically the system. A motor, 15, drives through a worm, 14, and cam, 11, a ratchet lever, 9, which moves step by step the control cam, 1, which has the pins, P, placed therein. The pins come behind the contact arms, 22a, and make the electrical circuit which operates the relay, E, which in turn closes the switch, 17, for commencing the operation of the heater. The switch when closed starts the fuel feed motor and ignites the fuel.

Three sets of pins, P1, P2, and P3, are provided for three different timing programs. It has been found that three different programs cover a great range of weather.

The desired program is set by the switch, 16, which may be moved to contacts 16a, b or c, which correspond to switches 22a, b, and c, respectively, and pins P1, P2 and P3. Throwing 16 to 16a, means that the program of P1 is chosen; 16b, P2; and 16c, P3.

New Electric Ignition for Perfection Oil Burner

A positive electric ignition incorporating a "hot wire" has been added to the new Perfection oil burner manufactured by the Perfection Stove Co., Cleveland, O.



Perfection Oil Burner

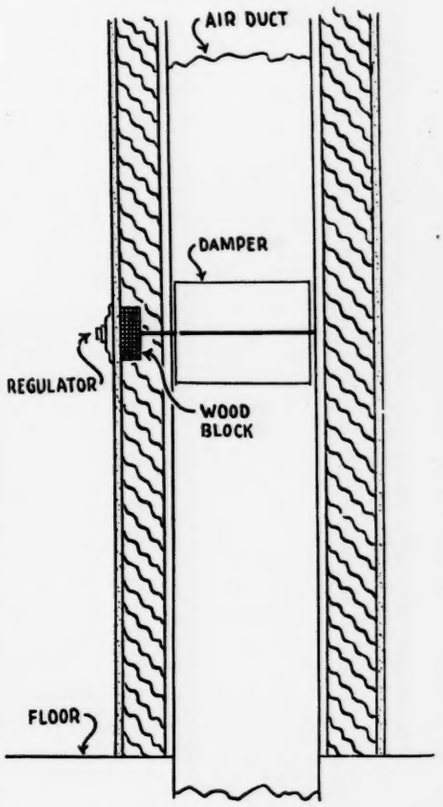
These burners previously were made only with the gas ignition system.

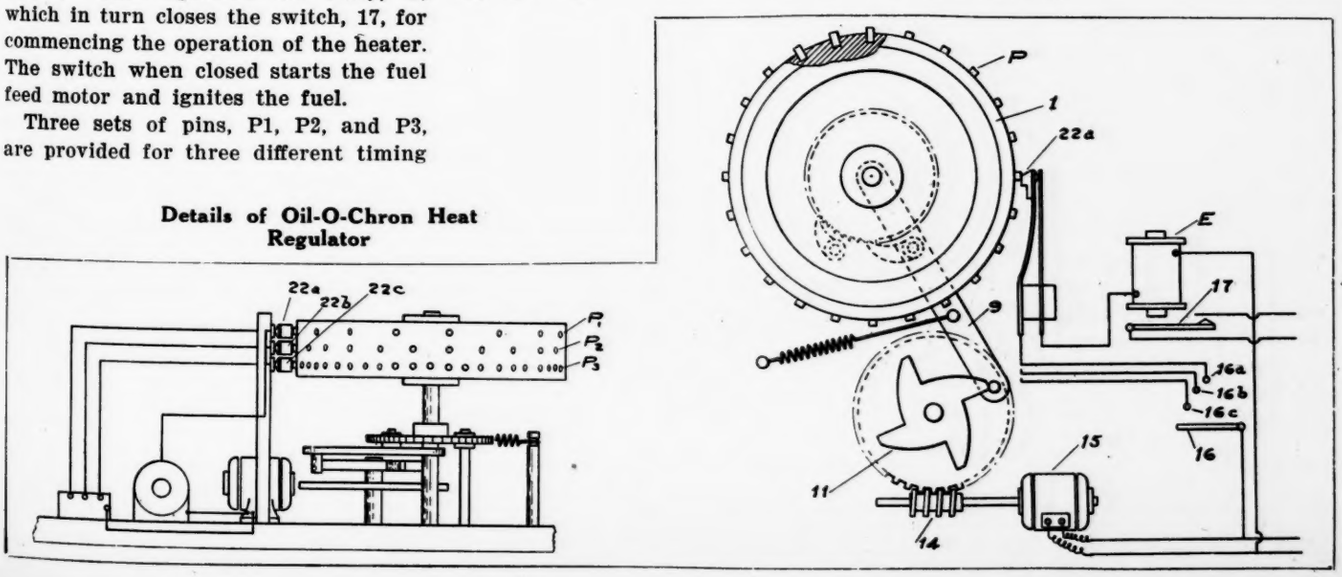
The gas ignition employs a by-pass valve which provides a momentarily large pilot flame at the moment of ignition. This feature insures a positive ignition and at the same time economy of operation because of the minimum consumption of the pilot when not actually igniting.

Young Regulator

The Young Regulator for ventilation control has been placed on the market by The Young Ventilating Co., 2703 Woodland Ave., Cleveland, O. The regulator controls the volume of air flowing through a ventilating duct by opening and closing the damper with which it is connected by a ⅜-in. square bar. The indicator and dial show accurately the position of the damper in the duct.

The damper is set by means of a wrench which also serves to lock the setting. The regulator is made of rust-proof metal, and can be obtained in chrome nickel.



Young Regulator for Ventilating Duct

Details of Oil-O-Chron Heat Regulator